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MODEL 5403/020-030

DIGITAL VOLTMETER

DANA

Instruction Manual

980191

MODEL 5403/020-030

DIGITAL VOLTMETER

November, 1966

DANA

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Section 1

General Description

1.1 INTRODUCTION

The Dana Model 5403 Digital Voltmeter, with plug-in module 020 or 030 and equipped with optional accessories, is a multiple function instrument capable of measuring DC volts, DC/DC ratios, millivolts, and AC volts. With Module 030, the additional capability of kilohm measurement is provided. The readings are displayed on a four-digit visual readout with an electrical output available for driving a printer or other recording device. Accuracy is preserved at the range cross-over points by a fifth "overrange" digit that extends each range by 10% (9999 to 109999).

The 020-030 plug-in module (on the right-hand side of the instrument) is a Signal Conditioning unit for the Model 5403 Digitizing and Display unit in the left-hand module. The function of the Signal Conditioning Module is to convert the various types of inputs and range selections into ten-volt full-scale DC voltages for measurement in the Digitizing and Display module.

Figure 1.1 - Model 5403

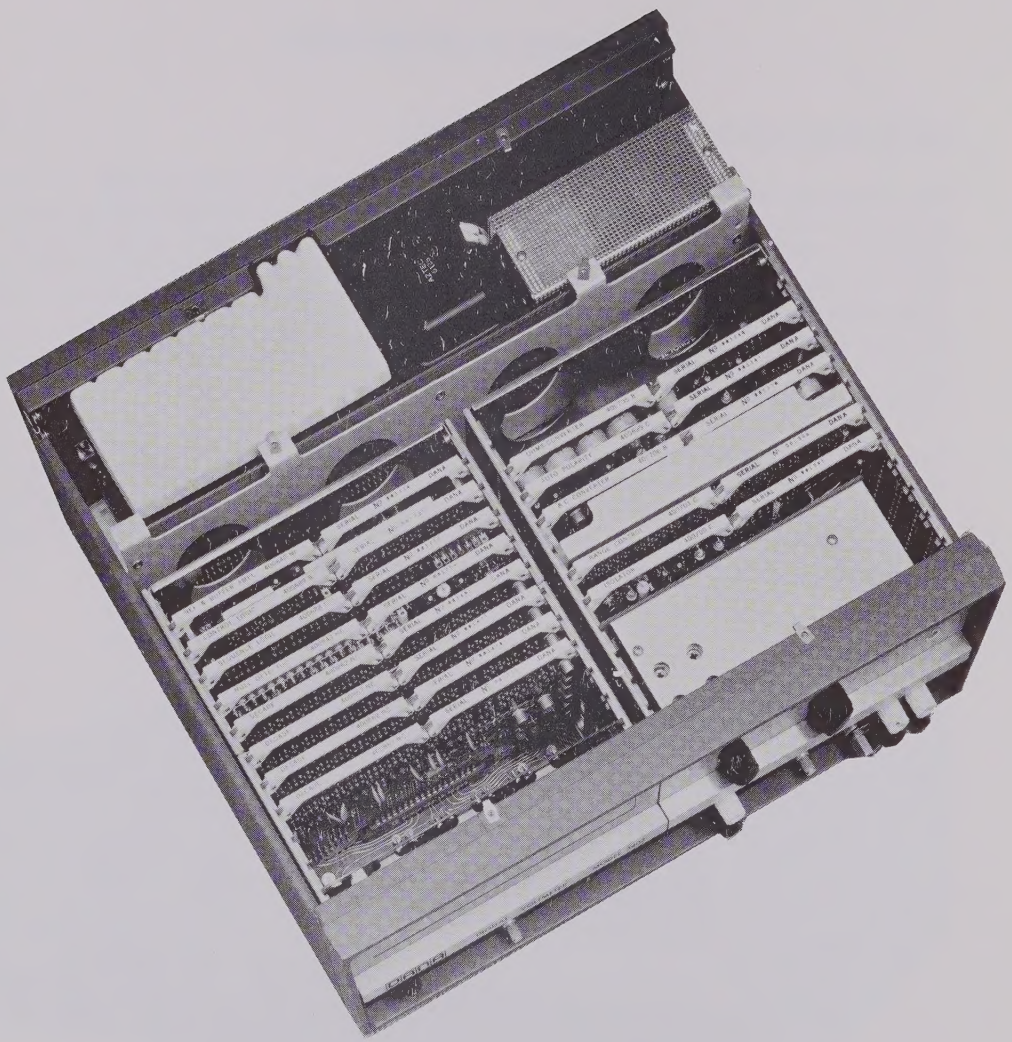


Figure 1.2. Model 5403 with Top Cover Removed

With an 020 module, the digital voltmeter is designated as Model 5403/020; with an 030 module, it is designated as Model 5403/030 (Figure 1.1). Since the two modules are identical except for kilohm measuring capability, descriptions referring to the "020-030 module" apply to both models. Description of kilohm functions apply only to Model 5403/030.

All functions and ranges are selected by switches on the front panel of the Signal Conditioning module. With an instrument equipped with a Remote Programming/ Electrical Output accessory (optional) the function and range can also be selected externally. This accessory also provides a binary-coded decimal (BCD) output for driving printers or other digital recording devices.

Two additional standard features of the Model 5403 are the Automatic Ranging function and the Analog output. With automatic ranging (Auto Range), circuits within the instrument determine the optimum range for the function being measured and switch to that range automatically. An analog output voltage, proportional to the signal being measured, is available at terminals on the front panel of the instrument. This voltage, at ten volts full-scale, allows analog recordings to be made in parallel with digital measurements. Many other applications for the analog output are possible — including its use as a precision voltage source.

All circuits, other than the power supply, are mounted on plug-in printed circuit boards. The power supply is located at the right rear of the instrument and can be removed as a unit. Next to the power supply is the Remote Programming/ Electrical Output accessory. Several accessories are available — providing either isolated electrical output, isolated programming, or both. Complete details of the output/programming options are included in the Appendix to this manual.

Two of the printed circuit boards in the Signal Conditioning module are offered as optional accessories. These are the Model 27 AC Converter and the Model 07 Ohms Converter. These boards and any of the output/programming accessories may be supplied with the instrument or added at any later time. The circuit boards contained in a fully-equipped instrument are listed on page 1-5 and shown in Figure 1.2. A block diagram, showing their electrical arrangement, is shown in Figure 1.3.

1.2 OPERATIONAL DESCRIPTION

The Dana Model 5403 Digital Voltmeter uses the null balance technique to measure the amplitude of unknown voltages. The Signal Conditioning module converts the input signal to a 10-volt full-scale analog voltage. For example, if the controls are set to measure AC volts on the 100-volt range, a 50-volt rms input signal results in an internal analog voltage of 5 volts DC. This voltage is applied to the Digitizing and Display module where it is "digitized" by comparison with a series of trial-and-error voltages, each of which is a known digital fraction of a reference voltage. Precision resistors in the reference-voltage divider or

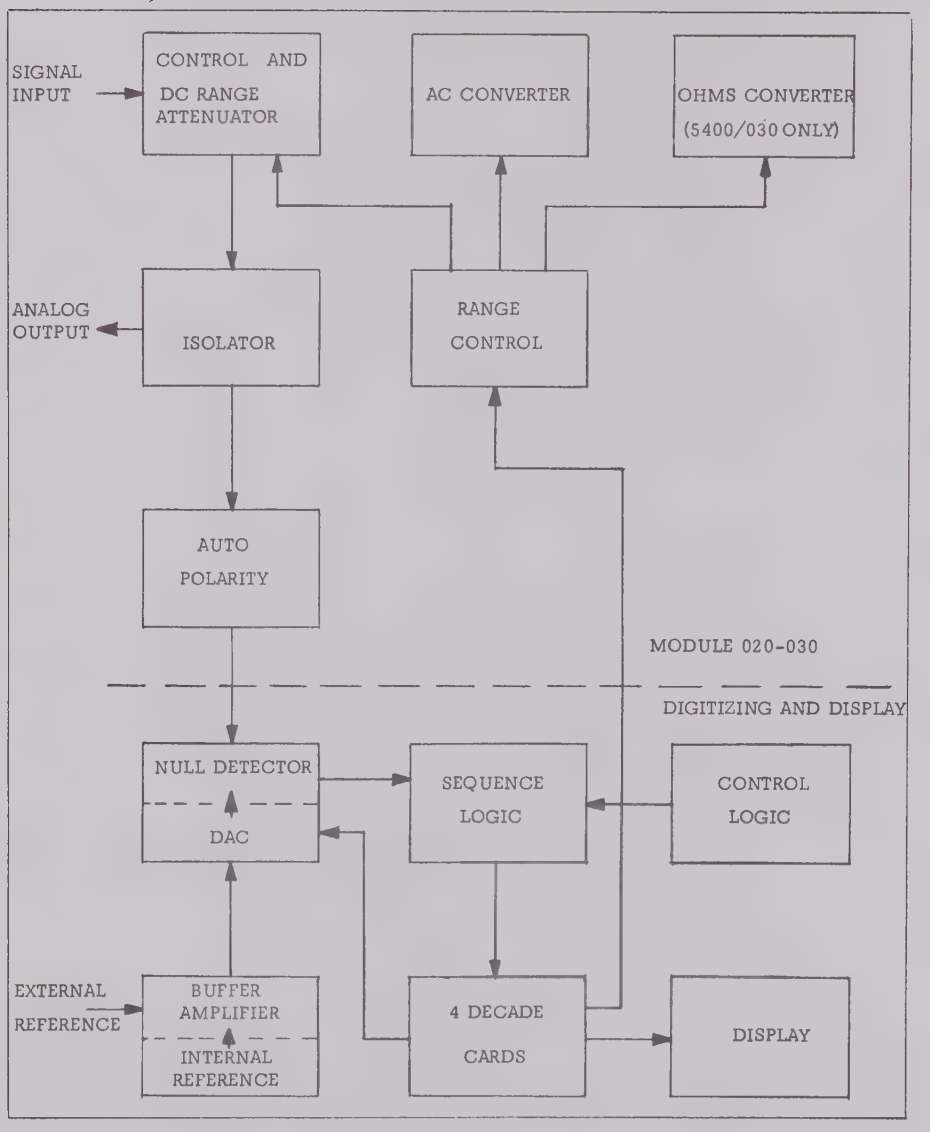


Figure 1-3. Block Diagram

REAR

ELECTRICAL OUTPUT AND PROGRAMMING	POWER SUPPLY
J11 - Reference Buffer	
J10 - Control Logic	J21 - Ohms Converter (030)
J 9 - Sequence Logic	J20 - Auto Polarity
J 8 - Null Detector	J19 - AC Converter
J 7 - 1 Decade	
J 6 - 10 Decade	J17 - Range Control
J 5 - 100 Decade	J16 - Isolator
J 4 - 1000 Decade	J15 - Control & Attenuator
J 1 - Display	

CONTROL PANEL

digital-to-analog converter (DAC) are capable of dividing the reference into 10,000 equally-spaced increments and to arrive at the closest increment in a maximum of 36 trials. The total digitizing time is less than 2 milliseconds.

When a null balance has been achieved, the digital setting of the DAC is displayed on the DVM visual readout. The number shown is, in effect, the ratio between the input signal and the reference voltage in parts per 10,000.

When absolute measurements are being made, a highly stable Zener-controlled, 10-volt internal reference is used. Since full scale analog voltage from the Signal Conditioning module is also 10 volts, the displayed value is read directly in DC volts, millivolts, AC volts, or kilohms, with proper placement of the decimal point to adjust for any ranging that has been performed.

In the above example, the 50-volt rms AC input signal would produce a 5-volt internal analog voltage, which would be balanced by the 10-volt internal reference when the DAC arrives at a value of 5,000 (parts per 10,000). The digital display would carry the numerals 5-0-0-0, and range information from the Signal Conditioning module would place the decimal point to read 50.00. An indicator symbol on the display would show that AC volts were being measured.

In the ratio measuring mode, the internal 10-volt reference is replaced by an external DC voltage, which may vary from +1 to +11 volts. The displayed value is the ratio between a DC input signal and the reference voltage at that instant. The ratio between +DC voltages and the reference are shown as plus (+) ratios; the ratio between -DC voltage and the reference as minus (-) ratios. This bipolar ratio capability is of particular value in applications, such as bridge balancing, where inputs are likely to pass through zero. Since the signal and reference voltages are being detected simultaneously, the accuracy of the ratio measurement is independent of the stability of the voltage source.

1.3 SPECIFICATIONS

DC VOLTAGE MEASUREMENTS	ABSOLUTE (0 to ±1000 v)	RATIOS (+1 to +11 v ref std, +10 to +110 available)
Full scale ranges, ranging and polarity automatic°	±10.999, ±109.99, ±1099.9 v (max input 1000 v)	±1.0999:1, ±10.999:1, ±109.99:1
Accuracy	±0.01% of reading and ±0.01% of f.s.	±0.01% of reading and ±0.01 (10v/E ref)% of f.s.
Temperature coefficient	±0.001% of reading per °C	±0.001% of reading per °C
Response time: Digitizing with polarity change	2 milliseconds	2 milliseconds
Range change	250 milliseconds per range	250 milliseconds per range
Full scale step function settling time (to 0.01%)	250 milliseconds with up to 100k-ohm source	250 milliseconds with up to 100k-ohm source
Common mode rejection: DC	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead
Normal mode noise rejection	40 db min, 59 Hz and up; increasing 18 db/octave; 80 db min, 300 Hz and above; three-pole Gaussian	same as absolute (input only)
Input resistance—at or off null: 10 range	1000 megohms	signal, 1000 megohms; ref, 20 megohms
other ranges	10 megohms	signal, 10 megohms; ref, 20 megohms

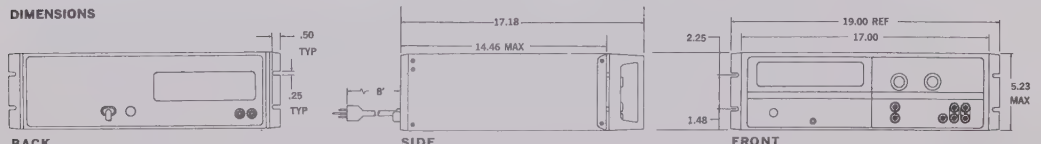
DC VOLTAGE MEASUREMENTS, FAST	
Full scale ranges, ranging and polarity automatic	±10.999, ±109.99, ±1099.9 volts (max input 1000 volts)
Accuracy	±0.01% of reading and ±0.01% of f.s.
Temperature coefficient	±0.001% of reading per °C
Response time: Digitizing with polarity change	2 milliseconds
Range change	250 milliseconds per range
Full scale step function settling time (to 0.01%)	10 milliseconds with up to 100k-ohm source
Common mode rejection: DC	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead
AC, 61 Hz and below	error <0.01% f.s. per 3 v common mode, with up to 100 ohms in either lead
Input resistance—at or off null: 10 v range	1000 megohms
other ranges	10 megohms

MILLIVOLT MEASUREMENTS	
Full scale ranges, ranging and polarity automatic	±109.99, ±1099.9 millivolts
Accuracy	±0.01% of reading and ±0.02% of f.s.
Response time (to 0.01%): Step response	1 second
Range change	250 milliseconds
Common mode rejection: DC	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead
Input resistance	100 megohms minimum

ACCESSORY SPECIFICATIONS	MODEL 27 AC CONVERTER	MODEL 07 OHMS CONVERTER
Maximum voltage rating	500 v rms, 50 Hz to 10 kHz, decreasing to 150 v at 50 kHz and up	not applicable
Maximum voltage across unknown	not applicable	10 v at f.s., max current 10 ma on 1 k range
Full scale ranges, ranging automatic	10.999, 109.99, 1099.9 v rms	1.0999, 10.999, 109.99, 1099.9, 10999 kilohms
Accuracy	50 Hz to 10 kHz: ±0.1% of rdg or ±0.02% f.s.	1, 10 and 100 ranges: ±0.01% of reading ±0.01% f.s.
	10 kHz to 50 kHz: ±0.25% of rdg or ±0.05% f.s.	1000 range: ±0.03% of reading ±0.01% f.s.
	50 kHz to 100 kHz: ±1% of rdg or ±0.1% f.s.	10,000 range: ±0.07% of reading ±0.05% f.s.
Response time: Step response	0.3 second to within 0.1% of final value	1, 10, and 100 kilohm ranges: 250 ms; 1 meg range: 0.5 sec; 10 meg range: 0.5 sec/meg
With range change	250 milliseconds per range	250 milliseconds per range
Common mode rejection: DC	not applicable	error <0.01% f.s. per 100 v common mode, with up to 100 ohms in either lead
AC, 61 Hz and below	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead	error <0.01% f.s. per 10 v common mode, with up to 100 ohms in either lead
Input resistance (all ranges)	1 megohm in series with 0.22 microfarad	not applicable
Shunt capacitance at terminals	less than 70 pf, all ranges	not applicable

GENERAL SPECIFICATIONS AND ORDERING INFORMATION	
Maximum common mode voltage	250 volts
Maximum power requirement	40 watts, 105 to 125 v (export 210 to 250v), 50 to 400 Hz
Warm up	1/2 hour to full accuracy
Operating temperature range	0° to +50°C
Signal input binding post connectors	front input: all instruments. Parallel rear input: (extra cost option) $40 (add -1 to model and module numbers, e.g., 5400-1/030-1).
Reference input binding post connectors	rear only
Analog electrical output (Modules 010, 020, 030 only)	10 v f.s. at 1 milliamp. Accuracy: dc and ohms, ±1 mv; ac as Model 27 above
Digital output and programming accessories	See Appendix A
Convenience hardware	Handles, part no. H450820, $15 per set. Rack Mounting Flanges, part no. F450820, $15 per set. Integral Handles-and-Flanges, part no. FH450820, $15 per set. Card Extender, part no. 410184, $15.
Weight	25 pounds (approx) net, 30 pounds (approx) shipping
Guarantee	12 months, faulty workmanship or component failure

DIMENSIONS



BACK SIDE FRONT

Section 2

Installation

2.1 UNPACKING AND INSPECTION

The Model 5403 Digital Voltmeter is crated in a plastic foam container consisting of two half-forms joined together and securely taped. The forms are contoured so as to hold the digital voltmeter firmly in place with the container absorbing any reasonable external shock. Before uncrating, examine the container for any sign of external damage.

Carefully cut the tape holding the two half-forms together and remove the digital voltmeter. Inspect the digital voltmeter for signs of damage. If damage is found, notify the carrier immediately.

Remove the two modules from the DVM enclosure by turning the knurled knobs counterclockwise and pulling on the aluminum channel across the front panel of each module. Be sure that all circuit boards are firmly seated in their connectors. Normally, there is no need to remove each board; however, a visual check for obvious damage should be made.

Reseat the modules by pressing them firmly into the connectors at the rear of each drawer assembly. Lock in place by turning the knurled knobs fully clockwise.

The Model 5403, as shipped, is designed for bench-top operation. A standup bracket is provided under the case to aid in reading the visual display. To adapt the Model 5403 for rack mounting, flanges are attached by removing the two screws holding the side panels to the front bezel casting and replacing them with the longer screws provided with the rack-mounting flanges. The flanges are supplied in pairs, with Part No. F-450820 applying to a pair of flanges alone. For integral flanges and carrying handles, specify Part No. FH-450820. For carrying handles only, specify Part No. H-450820.

2.2 POWER CONNECTIONS

A standard eight-foot, three-wire, power cable is supplied with the instrument. This cord connects to a three-pin power connector at the rear of the unit.

2.3 INPUT/OUTPUT CONNECTIONS

2.3.1 Inputs/Analog Output

Signal input and analog output binding posts are located on the front of the digital voltmeter. Binding posts for the reference input, used for ratio measurements, are located on the rear of the unit. Connection to these terminals are made with standard "banana" plugs. Models equipped with a rear input connector (designated as Model 5403-1) use a six-pin cable connector wired in parallel with the front-panel binding posts. The mating connector is supplied with the instrument. See Paragraph 2.4 for instructions on the use of the analog output. Pin assignments of the rear input connector are as follows:

Pin A	Signal Input +
Pin B	Signal Input -
Pin C	Ohmmeter Current +
Pin D	Ohmmeter Current -
Pin E	Not used
Pin F	Not used

2.3.2 Remote Programming/Electrical Output

The Remote Programming/Electrical Output accessory fits into the rear panel of the digital voltmeter enclosure. It carries two 50-pin connectors. The connector on the right-hand side (as viewed from the rear) is the Digital Output connector, J202. The left-hand connector is the Remote Programming Input connector, J204. Printers and other digital recording devices may be driven by the voltage-levels present on the pins of the Digital Output connector. Pin assignments of the two connectors are given in the "Pin Assignments and Coding" chart in the Electrical Output/Programming Options" manual along with instructions for wiring each option and directions for programming.

2.4 ANALOG OUTPUT

The analog output at the front panel terminals is $\pm$10 volts full scale for $\pm$DC signals, both volts and millivolts. It is a +10 volt full scale for kilohm measurements and a -10 volt full scale for AC measurements.

The analog output should drive a minimum 10,000 ohm load, since the maximum full-scale current should not exceed 1 milliampere.

In connecting the analog output to a strip-chart recorder or other analog device, it should be recognized that the black terminal of the analog-output pair is internally connected to the black signal-input connector. Ideally, therefore, floating or isolated recorders should be used to avoid ground loop problems.

2.5 INITIAL CHECKOUT PROCEDURES

Every instrument is completely checked out and calibrated before leaving the factory. The following procedure is performed to verify that no damage has occurred during shipment and that the instrument is operative. Slight deviations in readings during the following tests may be corrected by making simple adjustments. For instructions, refer to "Field Calibration." Any major discrepancies should be reported to the carrier and to Dana Laboratories immediately.

Prior to performing the checkout procedure, it may be advisable to refer to the Operating Instructions, Section 3.

2.5.1 Zero Check

1. Set FUNCTION control to MV and RANGE to 100.
2. Short input leads. Visual readout should display 000.00.

2.5.2 Polarity Gain Check

1. Set FUNCTION control to DC and RANGE to 10.
2. Apply a known voltage of approximately -10 volts to the input. Visual readout should display value of input voltage and proper polarity indication.
3. Reverse polarity of voltage at input (to approximately +10 volts). Visual readout should again display input voltage and proper polarity.

2.5.3 Range Check

1. Set RANGE to 100.
2. Connect input to a source of +100 volts DC.
3. Visual readout should display input value and proper polarity indication.
4. Vary input voltage and polarity and check for proper readout.
5. Repeat on 1000 volt range.
6. Repeat the above steps with range on mV and using 100mV and 1000mV inputs.

2.5.4 AC Check

1. Connect signal generator to input. Set FUNCTION switch to AC.

2. Set generator to 50Hz and check for proper readout at the following input voltages: 9 volts, 90.0 volts, and 125 volts.

2.5.5 Ohms Check

1. Measure standard resistors of values near full scale for each range.

2. Check for proper readout and ohms indication.

Section 3

Operation

3.1 CONTROLS

3.1.1 POWER ON-OFF Switch

This is a pushbutton switch that applies power to the instrument. When power is ON, the DVM display is always lit. The power switch is independent of both the left- and right-hand drawers. It electrically connects with the power supply at the rear of the instrument.

3.1.2 READ/HOLD Switch

This is a two-position switch that allows the operator a choice of a READ mode, in which new readings are commanded at a fixed rate of four per second, or a HOLD mode, which freezes the last previous reading indefinitely. HOLD is released by turning the switch back to the READ position.

3.1.3 FUNCTION Switch

This is a seven-position switch having the following positions:

1. REMOTE. In REMOTE, the selection of the function to be measured is made externally through the Remote Programming input.

2. FAST DC. This position selects high-speed, non-filtered DC measurements from 1mV to 1000 volts.

3. DC. This position selects medium-speed DC measurements from 1mV to 1000 volts. An input filter is installed in the circuit in this position.

4. 10X RATIO. This position selects the measurement of the ratio of the input voltage, applied across the input signal terminals, to a reference voltage, applied to the reference input terminals at the rear of the instrument.

5. AC. This position selects the measurement of AC voltages from 50Hz to 100kHz.

6. MV. This position selects the measurement of low-level DC voltages from 10 microvolts to 1000 millivolts.

7. K-OHM. (On 030 Signal Conditioning Module Only). This position selects the measurement of resistance from 1 ohm to 10 megohms.

3.1.4 RANGE Switch

The RANGE switch has five fixed range positions, an AUTO position, and REMOTE.

Fixed Ranges. The five fixed ranges are 1, 10, 1000, and 10,000. Inscriptions on the panel define the ranges which can be used with particular functions. AC, DC, and FAST DC measurements can be taken on the 10, 100, and 1000 volt ranges. Millivolts can be measured on the 100 and 1000 ranges. Resistance can be measured on all five ranges.

AUTO (Automatic). In this position, range is automatically selected by internal circuits.

REMOTE. In this position, the selection of range is made externally through the Remote Programming input.

3.2 MANUAL OPERATION

The Dana Model 5403 has been designed for the simplest possible level of operation. Once the instrument has been connected to the power line and to the signal source in accordance with the instructions in Section 2, the operator can make all the required measurements by setting the front panel manual controls to the indicated positions.

When switching from one type of measurement to another by turning the FUNCTION control, it is generally advisable to keep the RANGE switch on AUTO so as to avoid overloading the input circuitry. Also, care should be taken to avoid introducing more than 500 volts into the instrument while the FUNCTION switch is on AC, or more than 30 volts while the FUNCTION switch is on MV.

The digitizing time is so rapid that no bothersome flicker occurs on the digital voltmeter display between the four-per-second readings in the "read" mode. With a constant input signal the display appears to remain fixed. It is therefore normally most convenient to leave the READ/HOLD control on the READ position, using the HOLD position only for special applications, such as external command operation.

3.2.1 DC Measurements, Fast, Normal, and Millivolt

Attach the high side of the signal source to the white signal input terminal, the low side to the black signal input terminal. Normally the ground terminal (which is at the DVM chassis ground) is jumpered to the black signal input terminal by the supplied shorting bar. If the input signal cable has a shield, this should be attached to the black signal input terminal. To operate the DVM on a floating basis, detach the ground terminal from the black input signal terminal.

3.2.2 AC Measurements

Attach the high side of the signal source to the white signal input terminal, the low side to the black signal input terminal.

Normally the ground terminal (which is at the DVM chassis ground) is jumpered to the black signal input terminal.

3.2.3 Ratio Measurements

Attach the signal input as for the DC instructions above. Attach the +DC reference voltage with the positive side to the white EXT REF terminal on the rear panel of the instrument. The black EXT REF terminal is tied internally to the black signal input terminal, and this is normally jumpered externally to the ground terminal, which is at DVM chassis ground.

Because the black terminals are tied together, the instrument can by itself make only three-wire ratio measurements (i.e., the reference and signal voltages have a joint common). For four-wire ratio measurements, use a differential amplifier, such as the Dana 3400 or 635. Depending on application, the amplifier will be used on the reference or input.

3.2.4 Ohms Measurements (Model 5403/030 Only)

For two-wire ohms measurements, jumper the white ohmmeter current source terminal to the white signal input terminal, and the black source terminal to the black signal input terminal and the ground terminal. The signal leads to the unknown resistance may be connected to either set of terminals.

For four-wire ohms measurements, separate sets of leads are connected to the non-jumpered signal input and ohmmeter-current source terminals. These leads are connected to the unknown resistance in the manner shown in Figure 3.1.

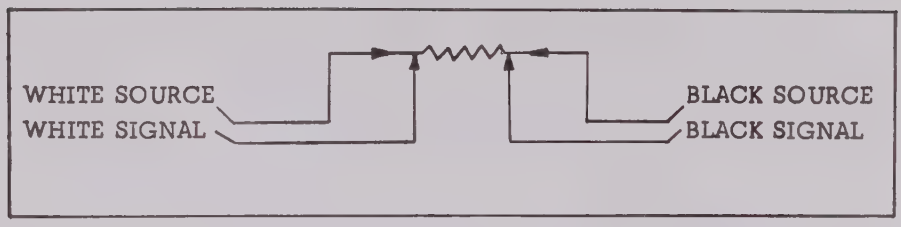


Figure 3-1. Four-Wire Ohms Measurement

3.3 REMOTE PROGRAMMING

The Model 5403/020-030 may be operated by remote contact closures or by a combination of front panel manual controls and remote contact closures.

Figures 5, 6, and 7, Appendix A, provides a list of pin assignments for the various instructions that may be programmed. An instruction is transmitted into the instrument by closing a contact between the indicated pin and the external supply voltage (12V). The instructions are not operative, however, unless the corresponding manual control on the front panel is set to its REMOTE position. Thus, to remotely program the range, the RANGE control must be set to REMOTE. The same is true of the FUNCTION control, if the function is to be remotely programmed. It is possible, however, to set one control manually (e.g., the range) while the other is being remotely controlled.

The Output/Programming Accessory includes a pin connection for commanding the instrument to take a reading. To enable this command function, the Model 5403 is put in the Hold mode, either by turning the front panel READ-HOLD control to the HOLD position or by providing an isolated contact closure between pin 32 and pin 25. A single reading can then be commanded by a momentary isolated contact closure between pin 8 and pin 25. The instrument immediately initiates a measurement cycle, and holds this measurement until the contact closure at pin 8 is broken and again made.

The Remote Programming feature allows the selection of AC/DC and MV/DC ratio measurements. With the Ratio select line tied to pin 25, the instrument is placed in the ratio measurement mode. With the FUNCTION switch set to AC, the readout will indicate AC and Ratio; measurements of AC/+DC ratio can then be performed. If MV is selected, $\pm$MV/+DC ratio measurements can be performed. Delay times for each function are listed in Appendix A.

Section 4

Theory Of Operation

4.1 INTRODUCTION

Theory of operation of the Model 5403 digital voltmeter is described in two parts. First, the Signal Conditioning module is described; then, the Digitizing and Display module. The purpose of the Signal Conditioning module is to supply a negative 10-volt full scale input voltage to the Digitizing and Display module. The Digitizing and Display module measures this input by balancing it against a known fraction of a fixed reference voltage.

The descriptions and simplified diagrams throughout this section are intended to supplement the complete schematics included in Section 6. Logic symbols used in the diagrams are defined in Figure 4.1.

4.2 SIGNAL CONDITIONING

A general description of each circuit board in the module is followed by an operational description of the measurement of each function.

4.2.1 General Description -- Circuit Boards

4.2.1.1 Control and Attenuator (Schematic 430310)

The Control and Attenuator is the first assembly behind the front panel. On it are mounted the front panel switches and input/output terminals. The board contains relays which switch the function and range displays; filters; scaling resistors; and a feedback attenuator for millivolt measurements. The relays are controlled by the function selection -- from either the front panel switch or through remote programming -- and by the range signals -- from either the RANGE switch, through remote programming, or from the Range Control board.

Six relays, K1 through K6, are used. K1 is shown on sheet 1 of the schematic; the others are shown on sheet 2. One side of each relay coil is tied to +28V; the relay is energized by applying a digital common level to the opposite side. The purpose of each relay is indicated in the following table.

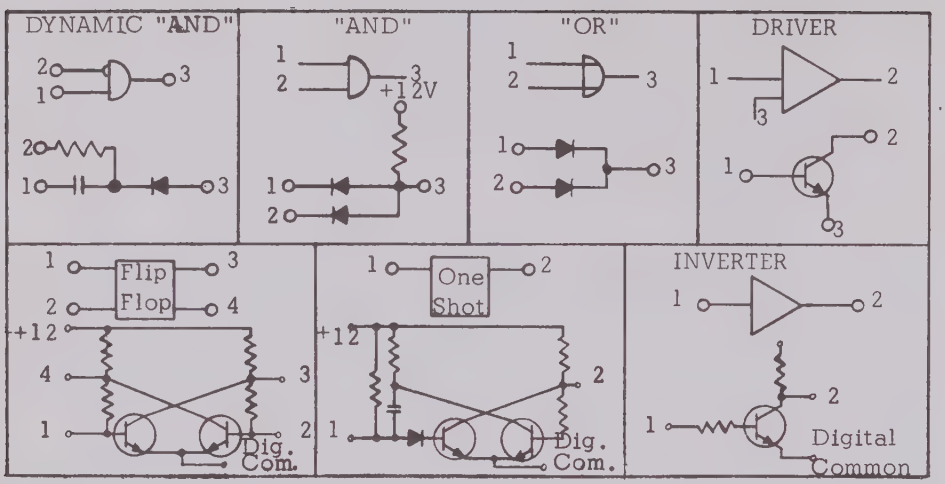


Figure 4.1 - Dana Logic Symbols

Relay	Energized by:	Purpose
K1	DC, Ratio selected	Adds active filter A to the input.
K2	Kilohms selected	Routes "current" source directly to Ohms Converter; adds active filter to circuit; installs input resistance in + signal input.
K3	AC selected	Switches high side of input directly to the AC Converter; switches active filter B into the circuit.
K4	MV selected	Switches passive filter into circuit; adds 10K feedback loop to Isolator and adds resistance network to ground.
K5	R1, R2, K-ohm	Range switching.
K6	R2	Range switching.

4.2.1.2 Isolator (Schematic 430305)

The Isolator is a floating-input differential amplifier capable of operating at very low signal levels. The feedback loop, that establishes amplifier gain, is located on the Control and Attenuator board. The feedback circuit and the amplifier input are switched into various configurations to conform to the function selected. The amplifier operates as a unity-gain isolator for DC, ratios, and resistance (5403/030 only) measurements; as a gain of 10 amplifier for AC measurements; and as a preamplifier for millivolt measurements on the 100 and 1000 ranges. A simplified drawing of the circuit changes as various functions are selected is shown in Figure 4.2.

Operating in conjunction with the Isolator amplifier is a "bootstrap" amplifier (consisting of Q5, Q6, Q8, Q10, Q11, and Q15, see schematic). This amplifier samples the voltage at the negative feedback point and adjusts the supply voltages to the input stage so that base and collector voltage remain constant. Also it provides a reference level for the first stage base current.

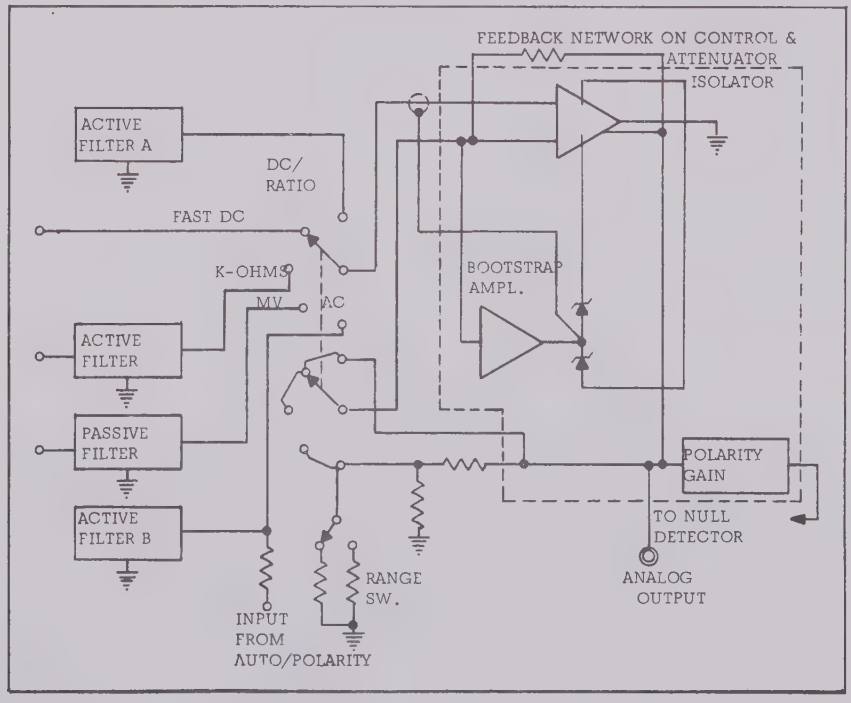


Figure 4-2. Isolator

4.2.1.3 Range Control (Schematic 430307)

The Range Control board consists of a three flip-flop counter which generates the range control signals, R1, R2, R3, and their complements. These signals are sent to the other boards throughout the Signal Conditioning module where they energize the proper range relays. The counter is controlled by signals from the Digitizing and Display module (Decade boards). Full-scale, represented by a count of 10999, causes Count Up Range to be "true;" one-tenth scale, represented by a count of 00999, causes Count Down Range to be "true."

The Count Up Range and Count Down Range signals have no effect on the counter except when the output of the Start/Stop Memory (S/S) one-shot is "true." This occurs when the S/S signal (generated in the Digitizing and Display module) goes "false" at the end of a digitizing process. The count signals can be inhibited also by the "forbidden range" logic explained in the following paragraphs. Normally the counter will count up as shown in the following table.

States			
R1	R2	R3	Range
0	0	0	1
1	0	0	10
0	1	0	100
1	1	0	1000
0	0	1	10,000

Since all ranges are not used for all functions, logic is present to prevent the counter from remaining on a prohibited range for a particular function. For example, with the Millivolt function selected, R2 is not allowed to reset and R3 is held "off" by the MV line applied to R2 and R3 through diodes CR37 and CR38. This allows only the 100 and 1000 ranges to be available with this function selected. Similarly, with the counter at 110 representing the 1000 range, a count-up pulse is inhibited unless the Kilohm function is selected — since that is the only function using the 10,000 range. The input line labeled Z is "false" when either AC, DC, DCF, or Ratio is selected. This line prevents the R3 flip-flop from setting — thereby skipping the 10,000 range.

Any fixed range, selected either manually or remotely, inhibits the automatic range function. This is done by the logic gate at the S/S Memory output.

4.2.1.4 AC Converter (Schematic 430306)

The Model 27 AC Converter is an accessory board that may be plugged into the designated position in the Module (Figure 4.3) at any time. No special wiring is required; however, recalibration is required. The AC Converter circuitry consists of an AC-coupled, wideband, low-level amplifier with one permanent feedback path for the 10-volt rms range and two shunt networks, switched into the circuit by reed relays K1 and K2 for the 100- and 1,000-volt rms ranges. The unit is an operational amplifier, with resistor-capacitor pairs at the input and on the feedback loop. The full-scale output, on all ranges, is approximately 3 volts rms for a 10-volt rms input signal.

The output is applied to the Auto Polarity Amplifier which, in AC mode, serves as a full wave rectifier (see 4.2.5).

Another relay, K3, is energized when AC is selected. It reroutes signals from the Isolator and Auto Polarity boards to obtain the proper circuit configuration for the measurement of AC volts.

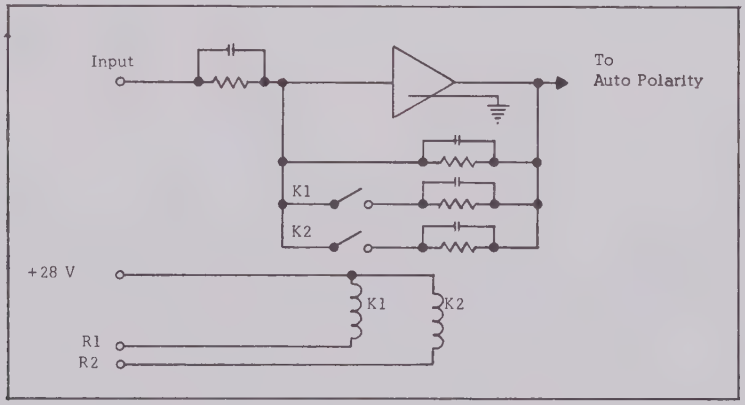


Figure 4-3. AC Converter

4.2.1.5 Auto Polarity (Schematic 430304)

The Auto Polarity board eliminates the need for polarity switching by maintaining (in conjunction with the Isolator output) a negative input to the Digitizing and Display module regardless of the polarity of the input. A simplified diagram of the Auto Polarity circuit is shown in Figure 4.4. The circuit consists of an inverting amplifier with polarity dependent feedback paths. The input resistor and feedback resistors are equal, resulting in unity gain.

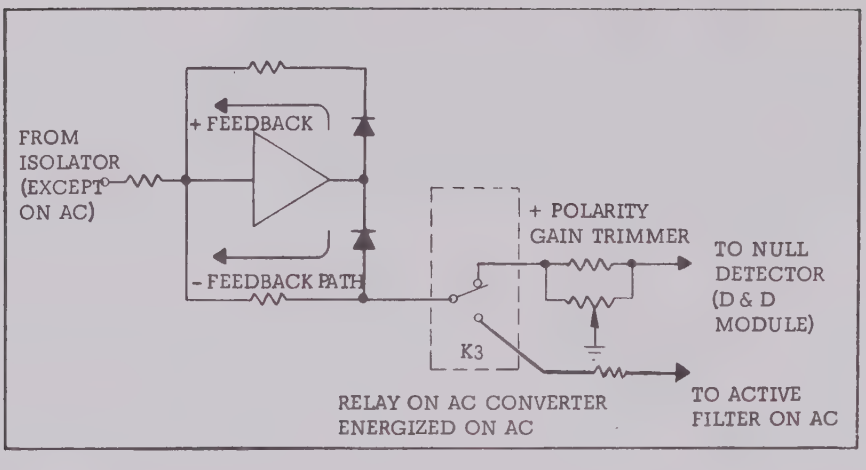


Figure 4.4. Auto Polarity

The input to the Auto Polarity board from the Isolator is of the same polarity as the input. It is scaled to 10 volts, full scale. A positive input to the Auto Polarity amplifier produces an equal negative voltage on the negative feedback path and zero volts on the positive path; a negative input voltage produces zero voltage on the negative path and an equal positive voltage on the positive feedback path. The input to the Null Detector is taken from only the negative feedback path. Therefore, the voltage at the positive gain trimming resistor is either zero (with negative input) or -10 volts full scale (with positive input).

With AC function selected, the input to the Auto Polarity board is from the AC Converter rather than from the Isolator and relay K3 is energized. The circuit then operates as a full wave rectifier since the in-phase AC from the AC converter is summed with the half-wave rectified Auto Polarity output; a filter is connected through the relay contacts from the feedback path. Relay K3 is energized by the selection of AC. Other contacts on the same relay rearrange the circuit configuration as described under "AC Measurement", paragraph 4.2.5.

4.2.1.6 Ohms Converter (Schematic 430303)

The Ohms Converter board (Figure 4.5) produces a constant and precise current which passes through the unknown resistance. The voltage drop across the resistance is determined by the voltage measuring circuits and displayed in Kilohms. The principal circuit element on the Ohms Converter board is a bridge differential amplifier. The voltage across the input terminals is the 10-volt

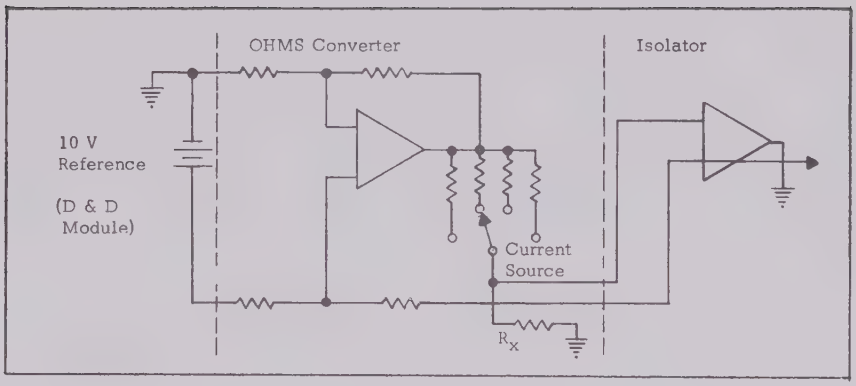


Figure 4.5. Ohms Converter

buffered internal reference generated in the Digitizing and Display module, referenced to the Isolator amplifier output. The output of the Ohms Converter amplifier is directed to the Isolator input through a network of current-determining "full-scale" resistors. The effect is to maintain a constant 10 volts across the full-scale resistors, regardless of the output of the Isolator amplifier. A 10-meg range resistor is constantly in the circuit. The other four resistors are inserted in parallel by the range relays.

4.2.2 Measurement of DC Volts and Ratios

The circuit configuration used for the measurement of DC volts is shown in Figure 4.6. (Note that the diagram is arranged to show the physical location of the boards. Locations, from left to right, represent module locations from front to rear). An identical arrangement is used when the instrument is in the ratio-measuring mode. The difference in these two types of measurements lies in the counter-balancing reference used in the Digitizing and Display module. DC volts are measured against a fixed internal reference; ratios are measured against an external reference.

As explained previously, the purpose of the Signal Conditioning module is to produce a negative 10-volt full scale signal (-10.999, including over-range) at the input of the Digitizing and Display module. The negative voltage is applied across precision resistors to produce a current that is nulled by an opposite current generated by the reference voltage.

The first step is to scale the incoming DC signal to 10 volts full-scale. The precision scaling resistors in the Control and Attenuator circuit divide the input voltage by 10 is the signal is between $\pm$10.999 and $\pm$109.99 volts, and by 100 if the signal is between $\pm$109.99 and $\pm$1,000 volts. The 10-volt full-scale input is then filtered to remove superimposed noise and fed into the input of the Isolator.

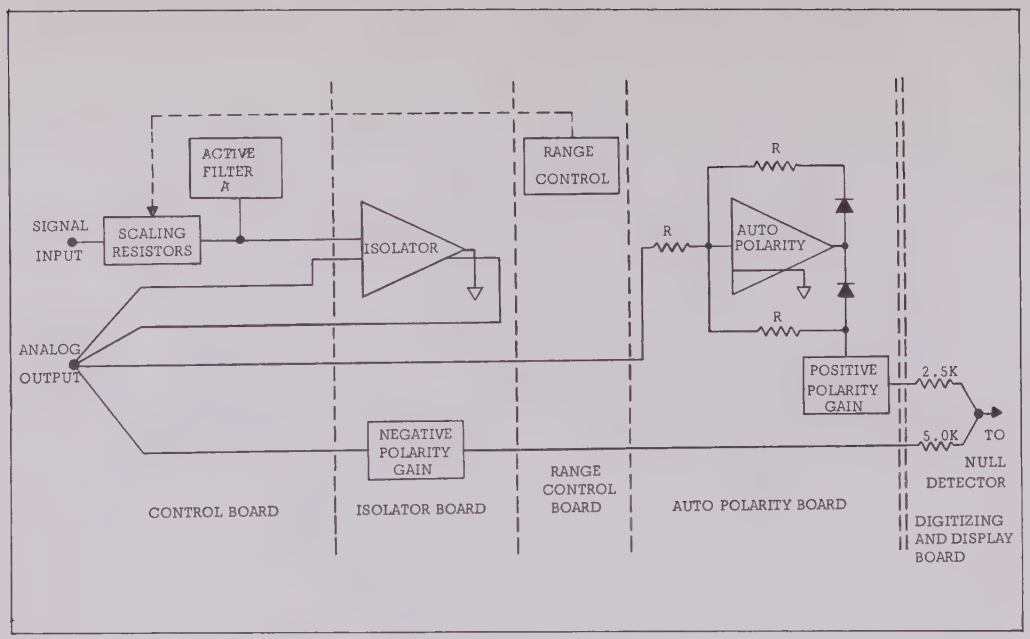


Figure 4.6. Block Diagram, DC and Ratio Mode

The Isolator is, in this mode, a unity gain amplifier. Its output is therefore identical in polarity and amplitude with the scaled input. The voltage is directed in parallel to two destinations: the input to the Null Detector via a 5,000-ohm resistor, and the input to the Auto Polarity amplifier.

As shown in Figure 4.4, only the negative-voltage feedback leg of the Auto Polarity amplifier is used. Since the amplifier is unity gain inverting, a negative voltage equal in amplitude to the isolator output is present only when the Isolator output is positive. When the Isolator output is negative, there is no signal output from the Auto Polarity amplifier since the positive-voltage loop is carrying the feedback. The Auto Polarity amplifier is connected to the null detector input via a 2,500-ohm resistor.

The current into the Null Detector, then, has two potential sources. If the input signal is negative, the Isolator output is negative and the Auto Polarity output is zero, and all of the required negative voltage is from the Isolator. On the other hand, if the input signal is positive, the Isolator output is positive and an equal negative voltage is generated by the Auto Polarity circuit. However, the resistance on the Auto Polarity leg of the null detector input is only half that of the Isolator leg. Therefore, the current resulting from the negative Auto Polarity voltage is exactly twice that of the current generated by the positive output of the Isolator. The net is a "negative" current that is precisely the same amplitude as the "positive" current that would be generated by the Isolator voltage alone.

The Auto Polarity amplifier derives its name from the fact that it allows the Null Detector to deal exclusively with negative currents from the Signal Conditioning module, without any delay for polarity switching. This is of particular importance when the signal is frequently passing through zero, as in the case of bridge balancing.

Field calibration includes trimming of the 5,000- and 2,500-ohm resistances at the Null Detector input by adjusting potentiometers on the Isolator and Auto Polarity boards (Polarity Gain adjustments). With a negative standard voltage input, only the Isolator voltage to the Null Detector is involved; the negative Polarity Gain adjustment on the Isolator is therefore calibrated first. When a positive standard-voltage input is applied, both current sources are contributing to the Null Detector input and, since Negative Polarity Gain has already been calibrated, the Positive Polarity Gain on the Auto Polarity board is adjusted for positive input voltages.

It is important to note that the Positive Polarity Gain adjustment is used to calibrate positive input voltages; however, the actual polarity voltage affected by this adjustment is always negative (or zero). By contrast, the Negative Polarity Gain adjustment is dealing with the Isolator output, which may be positive or negative, depending on the polarity of the input signal.

4.2.3 Measurement of Fast DC Volts

When Fast DC measurements are being made, the configuration of the Signal Conditioning module is the same as for DC measurements except that Active Filter A is removed. Elimination of the filter allows the instrument to settle to within 0.01% of the final reading in 10 milliseconds, after a step-function change in input level. The filter slows the settling time down to 250 milliseconds. Other than this change at the input, the fast DC mode is identical to that of the standard DC and ratio measurements.

4.2.4 Measurement of Millivolts

Module 020-030 "expands the scale" by switching the function of the isolator circuit, changing it to a preamplifier. Figure 4.7 illustrates the change in configuration from that shown in Figure 4.6.

A 10-kilohm feedback loop is added to the amplifier. This, in conjunction with a resistance network to ground, switches the gain of the amplifier to either 10 or 100. At a gain of 10, the instrument is operating at 1,000 millivolts full scale; at a gain of 100, the full scale is 100 millivolts and the last digit resolution is 10 microvolts.

A passive filter is used at the input to attenuate superimposed noise. Otherwise, the balance of the millivolt circuitry is identical to that used in measuring DC volts and ratios.

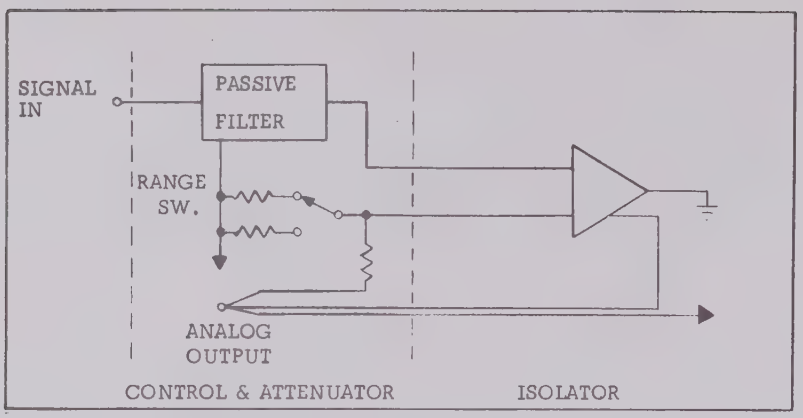


Figure 4.7. Circuit Changes for Millivolt Measurements

4.2.5 Measurement of AC Volts

The measurement of AC volts involves the addition of the AC Converter Amplifier and a major reorganization of the balance of the circuitry. Figure 4.8 illustrates this configuration.

The AC input signal is applied directly to the capacitor-coupled AC Converter Amplifier. The principal purpose of this amplifier is to scale the input down so that the output of the state is approximately 3 volts rms for a 10-volt rms, full-scale input signal. Input voltages in the 10-to-100 and 100-to-1,000 ranges are reduced by factors of 10 and 100, respectively.

The scaled-down voltage is applied to the Auto Polarity amplifier, which rectifies it and produces a negative voltage that is approximately $1/\pi$ of the input. A 10-volt rms full-scale input to the instrument is now reduced by exactly 1/10, to -1 volt.

The output of the Auto Polarity amplifier is filtered by active filter "B" on the Control and Attenuator Assembly board and then applied to the Isolator, which has been set to a gain of 10 (using the feedback resistors and attenuators that established the 1,000-millivolt range in the mV mode). The amplified negative voltage is, at this point, a 10-volt full-scale analog of the rms value of the AC input. It is fed directly to the current-determining 5,000 ohm resistor at the input to the Null Detector.

4.2.6 Measurement of Ohms (Model 5403/030 Only)

The ohms measurement configuration of the Signal Conditioning module is similar to that used in the measurement of DC volts and ratios. The Ohms Converter board has the primary function of generating a constant and precise current, which

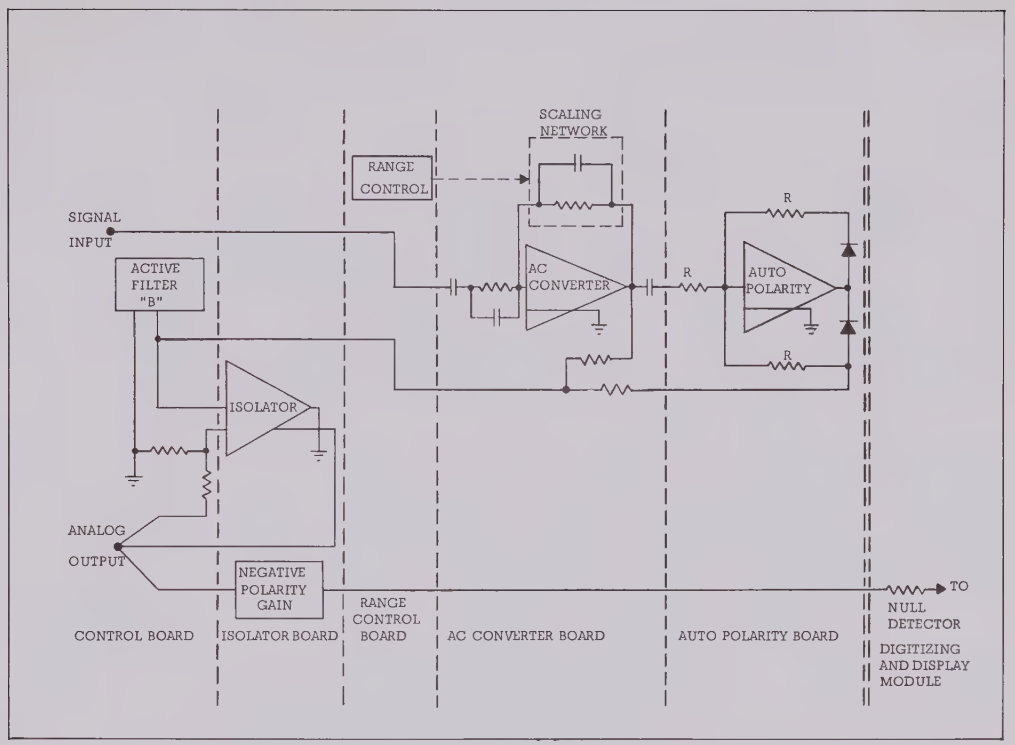


Figure 4.8. Block Diagram AC Mode

is then passed through the unknown resistor. The DC-measurement circuits determine the voltage drop and display the result as kilohms.

Figure 4.9 illustrates how the ohms converter is tied into the balance of the circuitry. The "constant" voltage applied across the full scale resistors is, in effect, the 10-volt reference voltage used in the null balance circuitry in the Digitizing and Display module. It is "bootstrapped" to the Isolator output, and the result is a constant 5 volts across the selected half scale resistor. The value of the range resistor is scaled to the constant five volts so that an unknown resistance of full scale value will develop ten volts. For example, on the 1000 range, the range resistor is 500 ohms and a 10ma constant current results. An unknown resistance of 1000 ohms produces a ten-volt input to the Isolator (0.010 x 1000 = 10).

4.3 DIGITIZING AND DISPLAY MODULE

A simplified drawing of the Model 5403 Digitizing and Display module is shown in Figure 4.10. Inputs from the Signal Conditioning module are applied to a summing junction at the input to the Null Detector. Regardless of the polarity of the voltage being measured, the sum of the currents from the Signal Conditioning

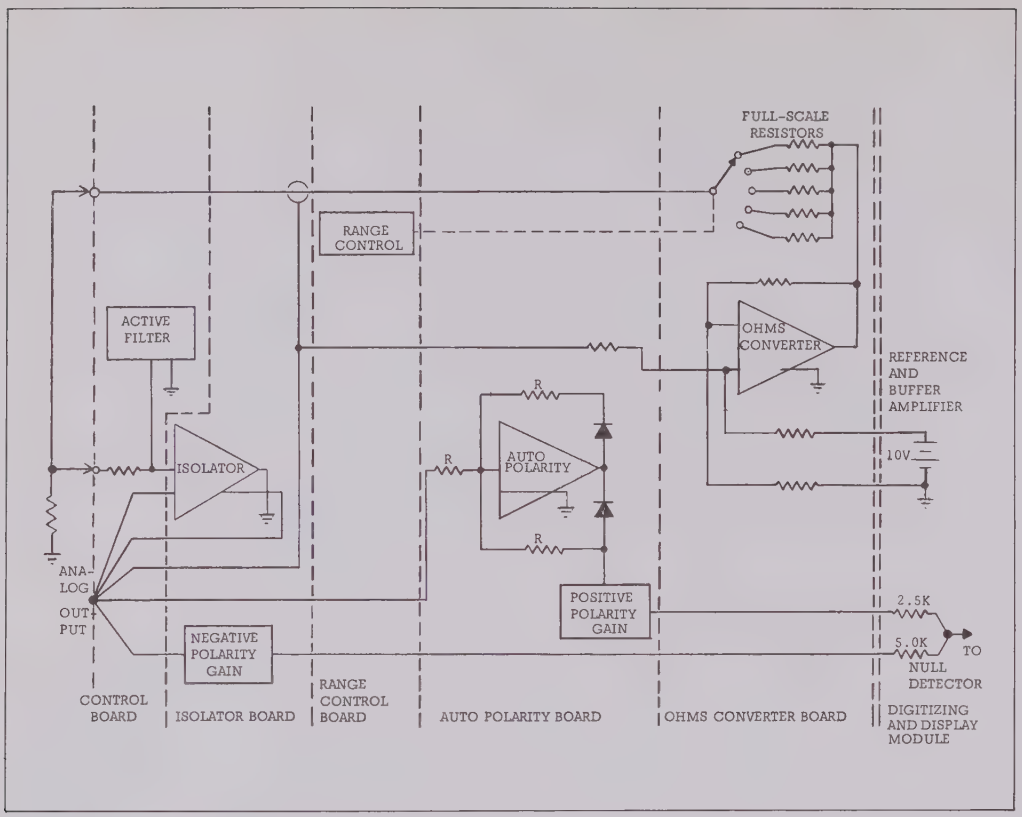


Figure 4.9. Block Diagram - Ohms Mode

module is always -2mA, full scale. This current is combined with a positive current from the DAC (Digital/Analog Converter) circuit.

DAC current supplied to the summing junction is the analog equivalent of the digital value represented by the state of the Decade flip-flops. When the summing junction is brought to null, the state of the flip-flops indicates the exact digital value of the input signal.

The digitizing process, or "conversion," begins when the Start/Stop flip-flop (on the Control Logic board) is set. Start/Stop is set by either of two conditions. The Display Rate circuit turns it on automatically every 250 milliseconds unless inhibited by a ground level at the Ground Hold input (READ/HOLD switch on HOLD) or a ground level at the Accessory Hold input. Start/Stop is also set by an external Command received through the remote programming input — or by an accessory command if the instrument is so equipped.

As Start/Stop is set, the negative-going edge of START/STOP sets the Reset flip-flop. RESET is inverted to become S9 (Set 9) and applied to each of the Decades. Each Decade has four flip-flops representing 2*-4-2-1 for that Decade. S9 sets the Decades to 9999. If, with the four Decades set to nines, DAC current is less than the input, the Overflow flip-flop is turned on by Overflow detecting logic

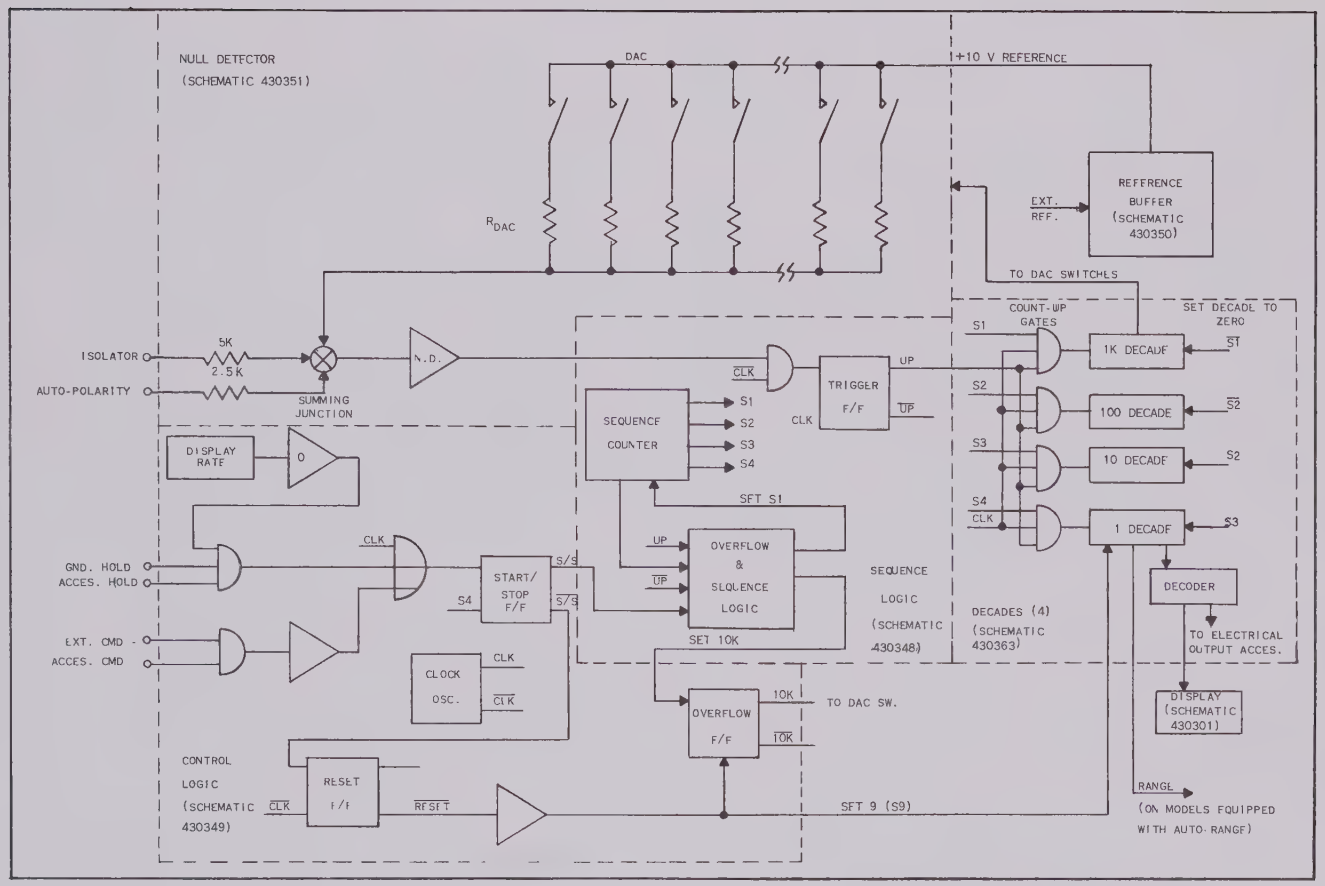


Figure 4.10. Block Diagram - Digitizing Module

on the Sequence Logic board. This adds additional DAC current representing a fifth digit (10K). If the resulting DAC current is still too low, the digitizing cycle is completed and the unit is made to up-range. If no higher range is available or permitted, the overrange condition (10999) may be printed to indicate an excessive input.

Normally, however, the initial setting of 9999 results in a DAC current greater than the input current. This condition is detected by logic on the Sequence Logic board; the Sequence Counter is stepped to sequence state 1 (S1).

In S1, the 1K Decade is "dropped" (each flip-flop "off"). The Decades are now set to 0999. If the resulting DAC current is less than the input current, the Null Detector causes the generation of UP at the Trigger flip-flop. The 1K Decade now counts up on each clock pulse until DAC current becomes equal to or greater than the input current. This condition is indicated by UP going "false." The Sequencer then advances to S2 and the 100 Decade is "dropped." If DAC current is less than the input current, the 100 Decade is counted up in the same manner as the 1K Decade. This is repeated for each succeeding Decade. At the end of S4, during which the 1 Decade is counted up, the Start/Stop flip-flop is turned off. At this time, the state of the Decades represents the digital value of the input signal and the conversion is complete. This operation is illustrated in the timing diagram of Figure 4.11. In the illustration the input is 03456.

4.3.1 Null Detector (Schematic 430351)

There are two main elements on the Null Detector circuit board (Figure 4.12): the precision DAC (digital/analog converter) resistor matrix controlled by the state of the Decade flip-flops — and the Null Detector itself, an amplifier that detects and amplifies any difference in input current and DAC current.

A summing junction at the input to the Null Detector receives inputs from the Signal Conditioning module. The input voltages are such that the sum of the current through the two input resistors is always negative. This can be seen by considering full-scale inputs to the instrument of both polarities (scaled to 10 volts). With a negative input voltage, the Auto Polarity voltage is zero. Therefore, the current through the 2.5K resistor is zero. The Isolator output is -10 volts; therefore, current through the 5K resistor is -2mA (-10/5K). With a positive input voltage, the Auto Polarity output is 10 volts applied back through the negative feedback leg of the Auto Polarity amplifier. This results in current through the 2.5K resistor of -4mA. At the same time the Isolator output is +10 volts resulting in +2mA through the 5K resistor (10/5K). The sum of the two currents (-4mA and +2mA) is -2mA.

The negative current is balanced out by a positive current from the DAC resistor network. This current is developed from a precise 10-volt reference voltage from the Reference Buffer circuit board for absolute measurements or from an external

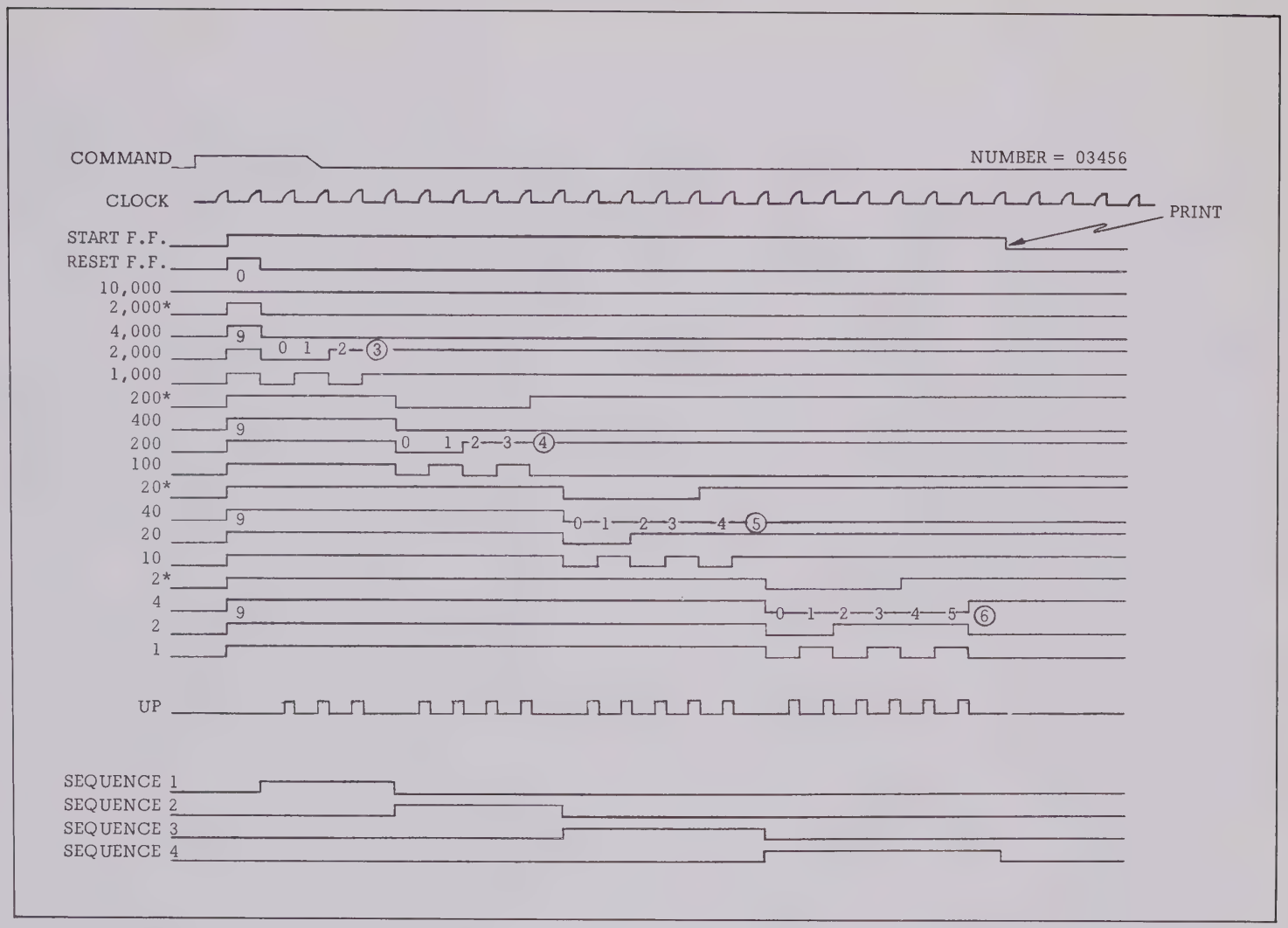


Figure 4.11. Timing Diagram (Without Overrange)

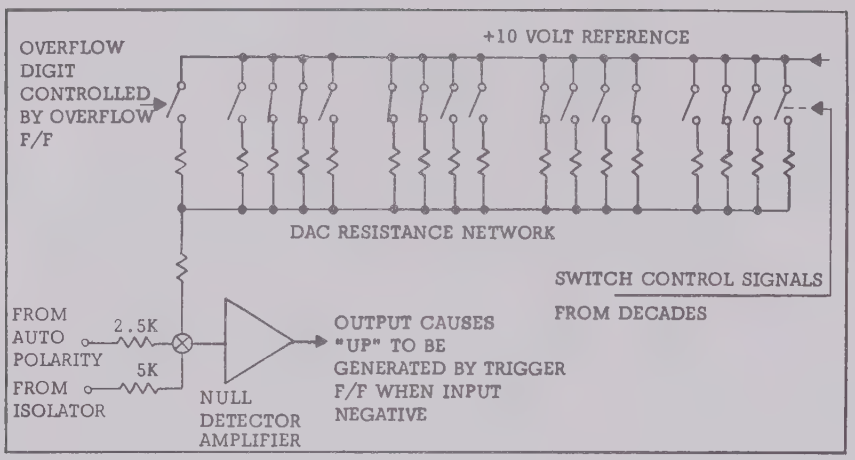


Figure 4.12. Null Detector

reference when ratios are being measured. In the initial condition where all four Decades are set to 9, the resistors are all switched into the DAC circuit. Since the resistors are in parallel, the resulting DAC current is maximum.

A typical DAC switch is shown in Figure 4.13. Q2 is normally on and R DAC is in the circuit. When a positive voltage is applied to the base of Q1, Q1 is turned on and the resulting ground level at the base of Q2 back biases Q2 and R DAC is out of the circuit. As shown in the figure, the switch is operated by the "not" side of the Decade flip-flop. When the flop-flop is "off" ("not" side true), the resistor is out of the circuit. Therefore, as a decade is counted up, resistance is added in parallel and DAC current increases at each step.

The positive DAC current is applied to the summing junction at the Null Detector input. If the DAC current is greater than the negative current from the Signal Conditioning module, the resulting current is positive; if the Signal Conditioning input is greater, the resulting current is negative. The Null Detector is a high-gain amplifier that provides an output of sufficient amplitude to trigger the Trigger flip-flop only when the input (summing junction) is negative. The Trigger flip-flop is located on the Sequence Logic board; its output is the UP signal. UP and its complement, $\overline{UP}$, control generation of the sequence states which, in turn control the counting operation of the Decades.

4.3.2 Decades (Schematic 430363)

There are four Decade boards in the instrument, all identical. The Decade board nearest the front of the instrument controls the 1000 digit; the second board the 100 digit; the third, the 10 digit; and the fourth, the 1 digit.

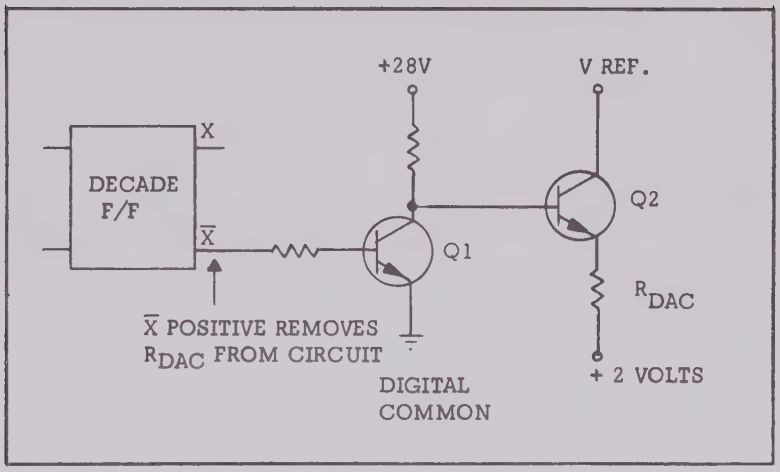


Figure 4.13. Typical DAC Switch

A simplified drawing of a typical Decade counter is shown in Figure 4.14. At the beginning of a conversion, after the Start/Stop and Delay flip-flops are set, the S9 line is made "true". This applies a positive voltage through R to the reset side of each flip-flop. This voltage sets each flip-flop and represents the "jam to nine" condition. If the Null Detector indicates that 9999 is greater than the input signal, the Sequence Logic places the instrument in sequence state 1 (S1). S1 is applied to the C_O input of the 1K Decade. As S1 goes "true," the negative-going edge of S1 places a negative voltage on the reset input of the flip-flop, thereby resetting it to zero. The "true" output of the flip-flop and of each remaining flip-flop on the Decade resets the following flip-flop as it goes "false" (on negative-going edge). Each flip-flop on the 1K Decade is now "off" and the value represented by the four Decades has changed from 9999 to 0999. S1 is applied to the input gate along with UP and a clock pulse. The Decade counter now counts up on each clock pulse. (SX, shown on the diagram, represents S1 to the 1K Decade, S2 to the 100 Decade, S3 to the 10 Decade, and S4 to the 1 Decade). Counting continues until UP goes FALSE. At this time, the Sequence Logic places the instrument in sequence state 2 (S2) and the 100 Decade is reset by S2 applied to the C_O input. The count-up operation proceeds exactly as in the 1K Decade, except that the input gate is now enabled by S2. The 10 Decade and 1 Decade counting operations begin on following UP signals. At the end of the 1 Decade counting operation (S4), the Sequence Logic counter and Start/Stop flip-flop are reset and no further sequence states are generated until the Start/Stop flip-flop is again set.

The "and" gates at the inputs to the 2 and 2* flip-flops adjust the count to eliminate "forbidden codes." Additional gates on the board receive various outputs from the flip-flops to detect the 0 and 9 states of the Decade for use of the range circuits in the Signal Conditioning module.

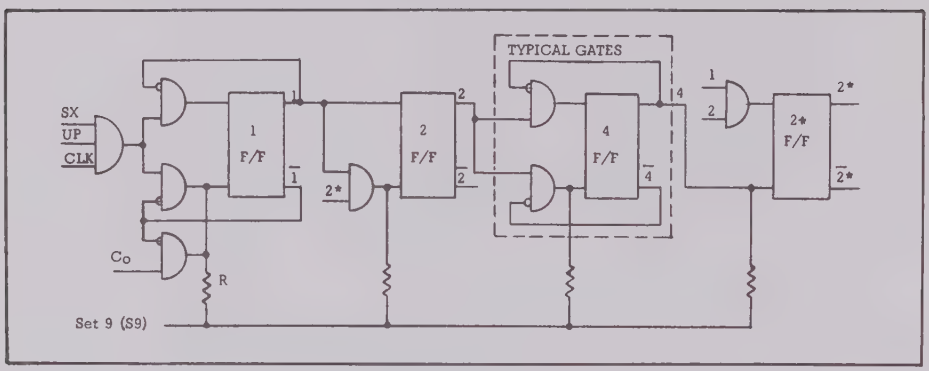


Figure 4.14. Typical Decade Counter

Also included on the Decade circuit board is a Decoder that interprets the State of the flip-flops and produces the drive voltage for the numerical display and the BCD data to the Electrical Output accessory. There are five lines to the lamp, each representing a pair of numerals; 0 and 1, 2 and 3, 4 and 5, etc. Separate control lines determine whether the even or odd numeral is to be lit. During the digitizing cycle, a blanking signal inhibits both the odd and even enable lines.

4.3.3 Sequence Logic (Schematic 430348)

A counter on the Sequence Logic circuit board (Figure 4.15) generates the four sequence states — or periods during which each Decade is reset to zero and then counted up. In addition, logic gates on the board determine when the sequence counter is turned on — and also detect the "overrange" condition where the input exceeds the four-digit capability of that range. Operation of the Sequence Logic is described in the following paragraphs; in the first case, it is assumed that the input does not require the overflow function.

Initially, each Decade is set to nine, the Overflow flip-flop (on Control Logic board) is off, and each flip-flop in the sequence counter is off. In this assumed case, the value represented by the Decade setting of 9999 is greater than the input signal, therefore the Trigger flip-flop is not turned on and $\overline{UP}$ is "true." $\overline{UP}$ enables an "and" gate which causes the S1 (sequence state 1) flip-flop to be set. Other inputs to the "and" gate are the clock, Start/Stop, and the "false" side of the sequence counter flip-flops to assure that S1 is not set at any time other than at the start of a conversion.

As S1 goes "true," $\overline{S1}$ goes "false." The negative-going edge of $\overline{S1}$ resets the 1K Decade to zero (as explained under "Decades") and S1 enables the input gate to allow the Decade to start counting. The 1K Decade counts up until $\overline{UP}$ is received.

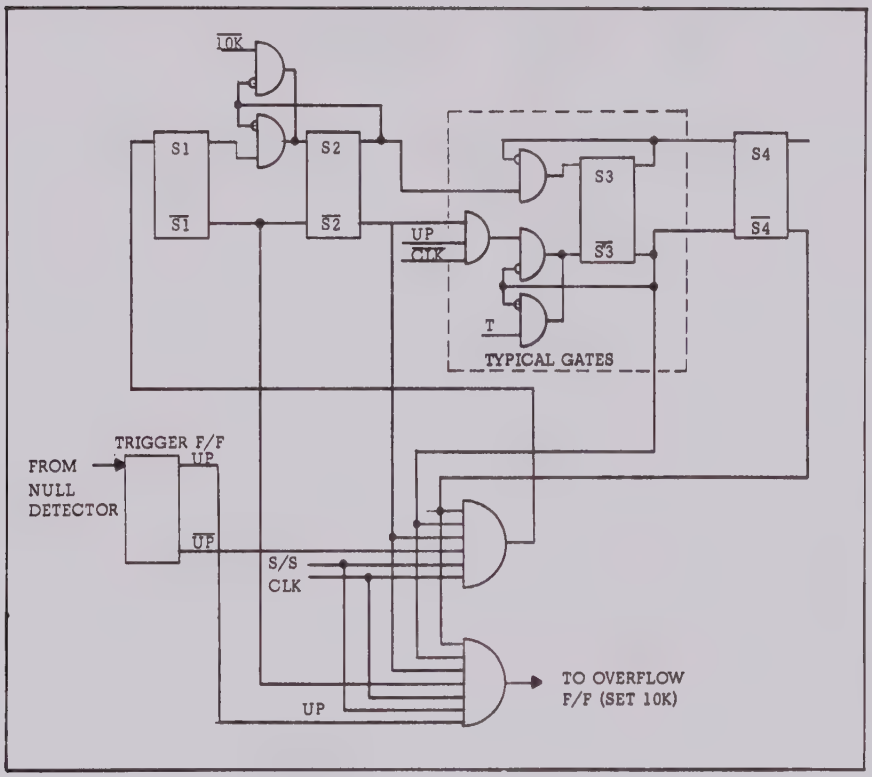


Figure 4.15. Sequence Logic

$\overline{UP}$ resets the S1 flip-flop in the sequence counter. On the negative-going edge of S1, flip-flop S2 is set. The negative-going edge of $\overline{S2}$ resets the 100 Decade to zero. S2 enables the input gate of the 100 Decade and it begins counting.

The Sequence counter advances to S3 on the next $\overline{UP}$ and the 10 Decade count operation is performed. Then S4 controls the counting of the 1 Decade. The 10 and 1 Decades are set to zero by S2 and S3 rather than $\overline{S3}$ and $\overline{S4}$ since their negative-going edges occur at the same time; this eliminates the need of bringing out two extra leads from the board. The negative-going edge of S4 resets the Start/Stop flip-flop.

The function of each sequence state can be summarized as follows:

$\overline{S1}$ resets 1K Decade to zero (on negative-going edge);
S1 enables 1K Decade count-up;
$\overline{S2}$ resets 100 Decade to zero (on negative-going edge);
S2 enables 100 Decade count-up, and
resets 10 Decade to zero (on negative-going edge);
S3 enables 10 Decade count-up, and
resets 1 Decade to zero (on negative-going edge);
S4 enables 1 Decade count-up, and
resets start/stop flip-flop (on negative-going edge).

The overrange condition exists when, after the Decades are initially set to 9999, an UP is received. This indicates that the value represented by the state of the Decades is full-scale but still less than the input signal. This condition is detected by an "and" gate on the Sequence Logic board which receives the UP signal along with the clock, Start/Stop, and the "not" outputs of the sequence counter flip-flops. When UP enables this gate, a signal (Set 10K) is sent to the Control Logic board where it sets the overflow flip-flop. The overrange bit has a logical weight of 10,000. If the overrange bit is "true", the readout is 10XXX. For reasons of linearity and accuracy, the analog weight of the resistor associated with this bit is 1000. This requires that the 1K decade be set to 9; this results in a total weight of 9 + 1 or 10. The readout does not indicate 19999, but the true analog weight of 10999.

If, after the overrange bit is set, the new comparison at the Null Detector results in an $\overline{UP}$, this indicates that the input is some value between 9999 and 10999. The negative-going edge of $\overline{10K}$ places the instrument into sequence state 3 (see Figure 4.15) and the conversion proceeds as described before, but with the 1K position remaining at 9 and the 100 Decade the first Decade "dropped."

If, after the overflow bit is set, an $\overline{UP}$ is received — indicating that 10999 is still less than the input, a digitizing cycle is performed and the unit is made to up-range (if instrument equipped for auto range). If no higher range is available, the overrange indication of 10999 is displayed (printed) to indicate an excessive input.

4.3.4 Control Logic (Schematic 430349)

A logic diagram of the Control Logic is shown in Figure 4.16. The conversion operation begins when the Start/Stop flip-flop is set. Start/Stop is set either automatically, by the Display Rate circuit, or by an external command.

The Display Rate circuit is an oscillator which delivers a pulse every 250 milliseconds when the READ/HOLD switch is in the READ position. The oscillator output is inverted and applied to an "and" gate. The gate is inhibited by Ground

Hold when the READ/HOLD switch is in HOLD — or by Accessory Hold if the line is at ground level. The Start/Stop flip-flop is set on the negative-going edge of the Display Rate signal. Start/Stop is also set when an external command is received through the programming input or by Accessory Command.

As Start/Stop (S/S) is set, the negative-going edge of $\overline{S/S}$ sets the Reset flip-flop. $\overline{RESET}$ is applied through an inverter to the Decades as S9 (Set 9). It sets the Decades to 9999 and resets the Overflow flip-flop to zero. The Reset flip-flop is turned off by the next $\overline{CLOCK}$.

The "true" output of the Start/Stop flip-flop is applied to an inverter. The inverter output is the blanking level which biases off the display lamps during the digitizing process. At the end of a conversion, Start/Stop is turned off by S4 (negative-going). This releases the blanking signal and, at that time, the state of the Decades is displayed.

The Overflow flip-flop is set by the Set 10K signal from the Sequence Logic board. Its output operates a corresponding a DAC switch, in the Null Detector, representing a "1" digit in the 10K position. This feature allows an overrange voltage to be measured and displayed.

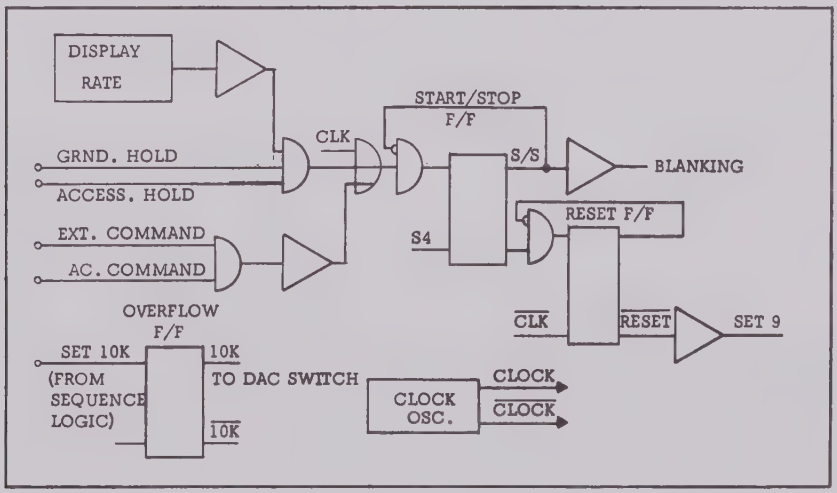


Figure 4.16. Control Logic

4.3.5 Reference and Buffer Amplifier (Schematic 430350)

The Reference and Buffer Amplifier board serves two functions: it produces a precise 10-volt internal-reference output for absolute measurements, and it serves as a high input impedance, low-output impedance, unity-gain, buffer amplifier for external reference voltages used in ratio measurements. A relay on the board (K1) switches the circuit from internal reference to external buffer when energized by the RATIO line from the FUNCTION switch. The internal reference circuit is based on the use of an aged Zener diode. Figure 4.17 shows the Reference and Buffer Amplifier board connected to the Internal Reference circuit. The Internal Reference is a divider network consisting of a fixed resistor, a potentiometer, and a Zener diode. The drive current for the Zener comes from the output of the Reference Buffer itself. Through careful selection of components and a balancing of the various resistances in the feedback network, an essentially zero temperature coefficient is achieved within the operating range of the instrument.

4.3.6 Display (Schematic 430301)

The Display board provides a mechanical assembly for the digital display tubes and carries the drive circuits for the neons that indicate decimal point, polarity, function, and range.

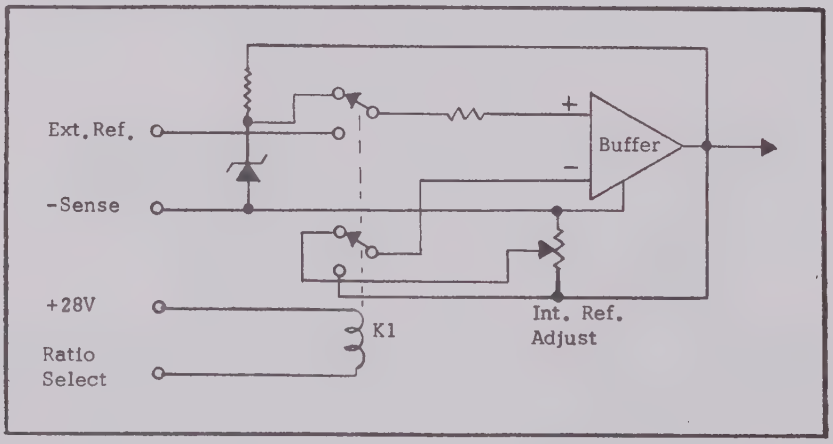


Figure 4.17. Internal Reference and Buffer

Section 5

Calibration

5.1 FIELD CALIBRATION

The field calibration of the Model 5403 is designed to keep the instrument operating within its specifications for indefinite periods of time. The procedures do not include the more detailed calibrations performed at the factory or following major repairs. These are described in 5.8.

Equipment required for the field calibration of the Model 5403 is limited to precision DC and AC voltage sources and a set of standard resistors:

DC Supply	- Fluke 332A or equivalent
Oscillator	- Hewlett-Packard 200CD or equivalent
Resistance Standard	- ESI SP1063 or equivalent

All adjustments are made on components located in the Module 020-030 drawer. Access to the components is from the top, requiring that the top cover of the instrument be removed. The AC and ohms adjustments are on the sides of their respective accessory boards, requiring an extender board for the calibration of these two functions.

Figure 5.1 illustrates all of the calibration points involved in the field calibration of the Model 5403.

5.2 ZERO CALIBRATION

Switch Function Control to millivolt and range to 100.

Short input leads

Adjust Zero Control (through front panel hole) until Model 5403 display reads 000.00.

5.3 MINUS AND PLUS POLARITY GAIN

Switch Function Control to DC and range to 10.

Connect input leads to known negative voltage near -10 volts.

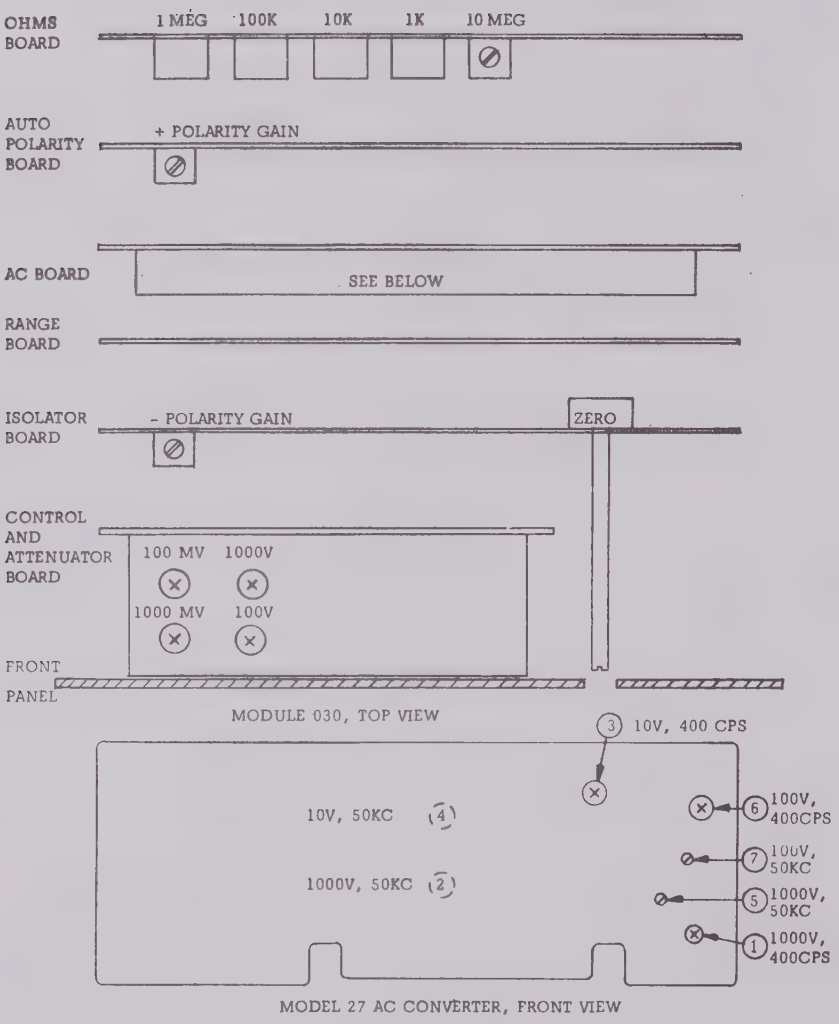


Figure 5.1 - Calibration Points - Model 5403/020-030

Adjust Minus Polarity Gain adjustment on Isolator Board until Model 5403 display reads value of known voltage.

Reverse polarity of input.

Adjust Plus Polarity Gain adjustment on Auto Polarity board until Model 5403 display reads value of known voltage.

5.4 RANGE CALIBRATION - VOLTS

Switch range to 100.

Connect input leads to ±100 volt source.

Adjust 100 volt range adjustment on Control board until Model 5403 display reads value of known voltage.

Switch range to 1000 and repeat first two steps above with ±1000 volt source and 1000 volt range adjustment.

5.5 RANGE CALIBRATION - MILLIVOLTS

Switch Function Control to millivolts.

Short input leads and check that instrument is still zeroed.

Repeat all of steps in 5.4 using ±100mV and ±1000mV sources and adjusting the 100mV and 1000mV adjustments on Control board.

5.6 AC CALIBRATION - VOLTS

Switch Function Control to AC and range to AUTO.

With AC board on extender, adjust capacitor (5) to middle of its span (see Figure 5.1).

Connect input leads to the following series of AC voltages and frequencies, adjusting the indicated adjustment until the Model 5403 displays the known voltage value:

Volts, RMS	Frequency	Adjustment (Figure 5.1)
125.00	400	(1)
125.00	50 kc	(2)
9.0000	400 Hz	(3)
9.0000	50 kc	(4)
125.00	50 kc	(5)
90.000	400 Hz	(6)
90.000	50 kc	(7)

When all adjustments are completed, check accuracy of ranges of 50 Hz, using voltage inputs of approximately 9.0, 90.0, and 125 volts.

5.7 KILOHMS CALIBRATION (Model 5403/030 only)

Switch Function Control to Kilohms and Range Control to AUTO.

Connect input to a 10-megohm standard and adjust the 10-megohm range adjustment on Ohms board until the Model 5403 displays correct value.

Repeat with standard resistors near full scale of remaining four ranges, adjusting appropriate controls on Ohms board to produce correct values on Model 5403 display.

5.8 RECALIBRATION

The following procedures are used for the more detailed calibration normally performed after repair of the instrument. Equipment required includes:

Microvoltmeter	- Medistor A-60RB or equivalent
Dekavider	- ESI Model RV622A or equivalent (six dial)
DC Supply	- Fluke 332A or equivalent

5.8.1 Preparation for Test

(a) Apply power to Model 5403/OXX and test equipment; allow one-half hour warm-up.

(b) Remove top cover of Model 5403.

5.8.2 Preliminary Zero Adjustment

(a) Place Null Detector circuit board on extender board. Attach jumper wire across C2 (Drawing 400843).

(b) Turn R18 (Drawing 400843) in a clockwise direction until the DVM displays random numbers; then return in a counterclockwise direction until the display time of all-zeros and of random numbers is approximately equal.

(c) Remove jumper; remove Null Detector board from extender and replace in normal position in DVM.

(d) Adjust line voltages to exactly 115 volts. Short the DVM input leads together. Turn R11 on Auto Polarity board (Drawing 402056) clockwise until readings are constantly changing as potentiometer is turned; then return in a counterclockwise direction to the point where readings just stop changing (the display may not be zero).

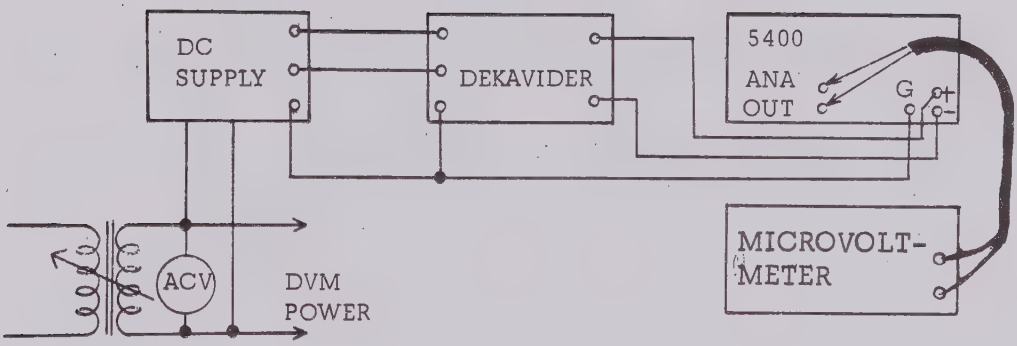


Figure 5.2 TEST SET-UP #1

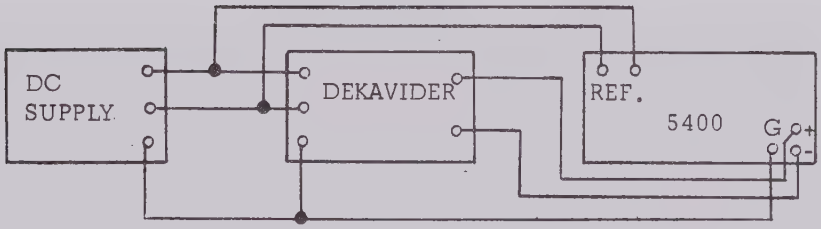


Figure 5.3 TEST SET-UP #2

(e) Connect test set up as shown in Figure 5.2. Set DC power supply to -9.0 volts; adjust Dekavider until the microvoltmeter reads -2.0 millivolts.

(f) Adjust R4 on Null Detector board (Drawing 400843) until the 5403 display "bounces" between -1 and -2 digits.

(g) Reverse polarity of the DC power supply voltage to obtain +9.0 volts.

(h) Adjust Dekavider until the microvoltmeter reads +2.0 millivolts.

(i) Adjust R11 on Auto Polarity board (Drawing 402056) until the display on the Model 5403 bounces between +1 and +2 digits.

(j) Repeat steps (e) through (i) to correct for interaction between the adjustments.

5.8.3 Final Zero Adjustment

(a) Short DVM input leads. Place Isolator board on extender. With a jumper wire, connect the shorted input leads to pin u on the Isolator (Drawing 400700). A convenient tie point is the left-hand side of R1.

(b) Set R15 to the center of its mechanical span. Adjust R13 until the microvoltmeter reads zero, $\pm$100μvolts.

(c) Remove jumper from pin u to input leads. Adjust R17 until the microvoltmeter again reads zero, $\pm$100μvolts.

(d) Remove Isolator board from extender and replace in normal position in the DVM. Switch the Model 5403 DVM function to millivolts. Correct any discrepancy from zero by adjusting the MV zero control on front panel.

5.8.4 Ratio Linearity Adjustment

(a) Connect the test set up shown in Figure 5.3. Connect the Model 5403 white external reference terminal to the high side of the Dekavider input. Set 5403 to the Ratio mode.

(b) Set power supply output to +10.0 volts. Set the Dekavider to 0.999900. Record the reading as displayed on the 5403.

(c) Decrease power supply voltage to 1.0 volt. Adjust R9 on Reference Buffer circuit board (Drawing 400840) until the Model 5403 display equals the value recorded in (b).

(d) Repeat steps (b) and (c) until there is less than three digits change in the reading when the power supply voltage is changed from ten volts to one volt.

5.8.5 Reference Buffer Calibration

(a) Place FUNCTION switch on Model 5403 to DC. Connect the + input lead of the microvoltmeter to the white test point at the top of the Null Detector board.

(b) Adjust R5 on the Reference Buffer (Drawing 400840) for a reading on the microvoltmeter of 10 volts ±50 μv. This value must be obtained by approaching it slowly from a lower value.

5.8.6 ±Polarity Gain Adjustments

(a) Connect test set up as shown in Figure 5.2. Set power supply voltage to -10.0 volts. Adjust Dekavider for -10 volts ± μv reading on microvoltmeter.

(b) Adjust R6 on Isolator board (Drawing 400700) to point where the 5400 display "bounces" between -9.998 and -9.999.

(c) Reverse polarity of power supply voltage so that input to Dekavider is +10.0 volts. Adjust Dekavider for +10 volts ±100μv reading on microvoltmeter.

(d) Adjust R3 on Auto Polarity board (Drawing 400699) to the point where the 5403 display "bounces" between +9.998 and +9.999.

(e) Repeat steps (a) through (d) and readjust for any interaction between adjustments.

(f) Check accuracy of the above adjustments with line voltage to the Model 5403 varied from 100 to 130 volts (rms).

SECTION 6

DRAWINGS AND PARTS LIST

6.1 DRAWINGS

The following drawings are included in this section:

Wiring Diagram - Interconnection 5403	430397
Wiring Diagram - Intraconnection	430362
Wiring Diagram - Intraconnection - 020	430418
Wiring Diagram - Intraconnection - 030	430419
Assembly - Control and Attenuator - 020	400858
Schematic - Control and Attenuator - 020 (2 sheets)	430464
Assembly - Control and Attenuator - 030	400698
Schematic - Control and Attenuator - 030 (2 sheets)	430310
PC Board Assembly - Switch Panel - 020	402158
PC Board Assembly - Switch Panel - 030	400704
PC Board Assembly - Auto Polarity	402056
Schematic - Auto Polarity	430415
PC Board Assembly - Range Control	402197
Schematic - Range Control	430501
PC Board Assembly - Ohms Converter	400705
Schematic - Ohms Converter	430303
PC Board Assembly - AC Converter	400706
Schematic - AC Converter	430306
PC Board Assembly - Isolator	400700
Schematic - Isolator	430305
Rear Input Plug Assembly - Four Wire	402009
Rear Input Plug Assembly - Two Wire	402010
PC Board Assembly - Display	400691
Schematic - Display	430301
PC Board Assembly - Basic Decade 5403	400891
Schematic - Basic Decade 5403	430390
PC Board Assembly - Null Detector	400843
Schematic - Null Detector	430351
PC Board Assembly - Sequence Logic	400688
Schematic - Sequence Logic	430348
PC Board Assembly - Control Logic	400689
Schematic - Control Logic	430349
PC Board Assembly - Reference and Buffer Amplifier	400840
Schematic - Reference and Buffer Amplifier	430350

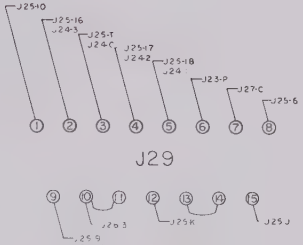
DRAWINGS (Cont)

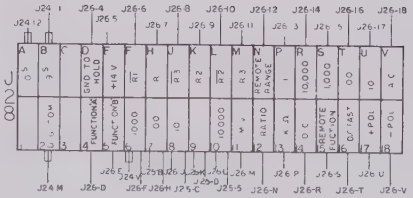
Power Supply Assembly - 5403	402000
PC Board Assembly - Power Supply - 5403	402316
Assembly - Capacitor - 5403	402019
Schematic - Power Supply - 5403	430571
Wiring Diagram - Enclosure 5400-1	430400

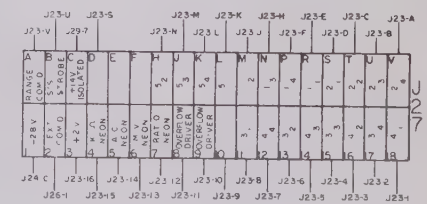
6.2 PARTS LISTS

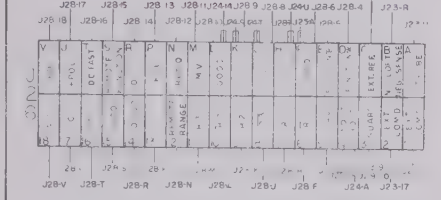
Parts Lists follow the drawings in the same sequence in which the drawings are listed.

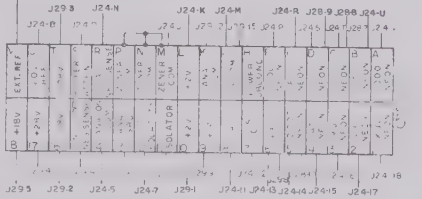
J29 PIN FUNCTIONS	
PIN	FUNCTION
1	+2 V
2	18 V
3	-28 V
4	+28 V
5	+18 V
6	+40 V
7	+14V TO CALIBRATED
8	+300 V
9	+1 V
10	GUARD
11	GUARD
12	ANA. COMMON
13	SPARE
14	SPARE
15	DIG COMMON

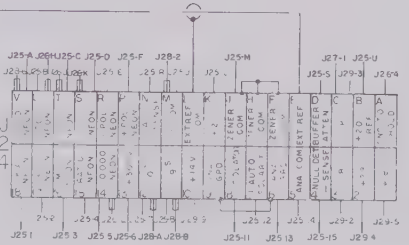


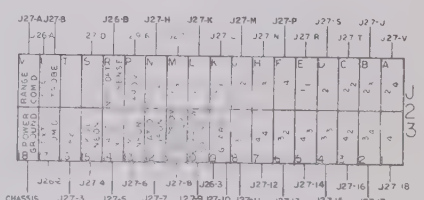












2. LEADS INDICATED THUS: CONSIST PARTIALLY OF 22 GA TINNED BUSS WIRE (P/N 500004) INSULATED WITH 20 GA TEFLON SLEEVING (P/N 501376).

1. CONNECTORS SHOWN AS VIEWED FROM REAR OF INSTRUMENT: THUS J 23, J 24, J 25 AND J 26 ARE ON FAR SIDE OF INTERCONNECTION BOARD; J 27, J 28 AND J 29 ARE ON NEAR SIDE.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	MA	FA
APPLICATION		QTY REQD	
702001	5" S/S 2500	REF	REF

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D-70327

CONTRACT NO.

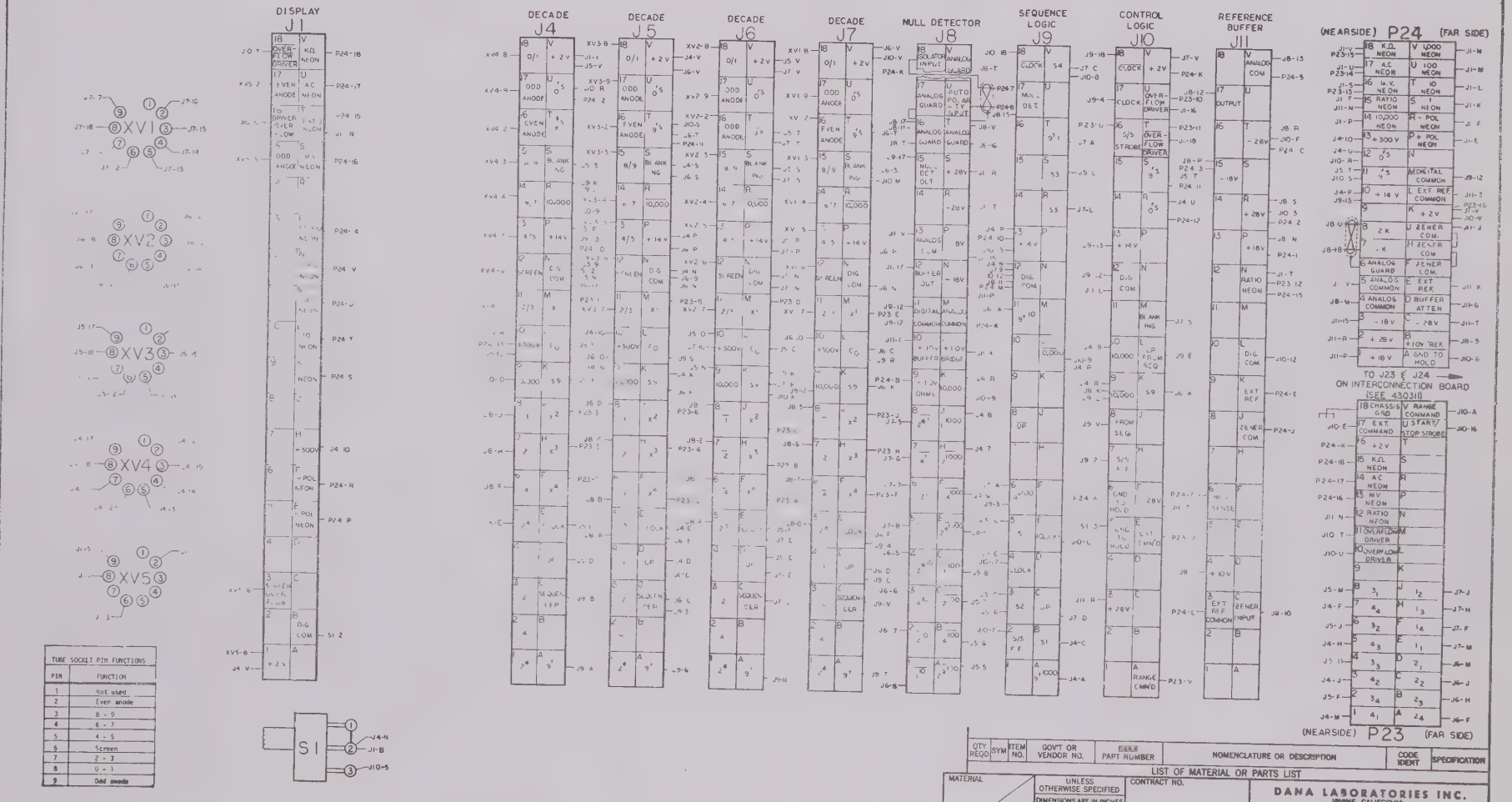
	NAME	DATE
DR	A CHAUSSEE	4 21 66
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM - INTERCONNECTION.

SIZE D | CODE IDENT NO. | DWG NO. 430397

SCALE — | WT — | SHEET 1 OF 1



TUBE SOCKET PIN FUNCTIONS	
PIN	FUNCTION
1	Not used
2	Even anode
3	8 - 9
4	6 - 7
5	4 - 5
6	Screen
7	2 - 3
8	0 - 1
9	Odd anode

1. CONNECTORS VIEWED FROM BOTTOM OF INSTRUMENT (DIP PIN SIDE).

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030, XX ± .020, XXX ± .010 ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	W. E. DIE	1-13-66
CHK	H. Curtis	1-17-66
APPD	J. Nelson	1-17-66

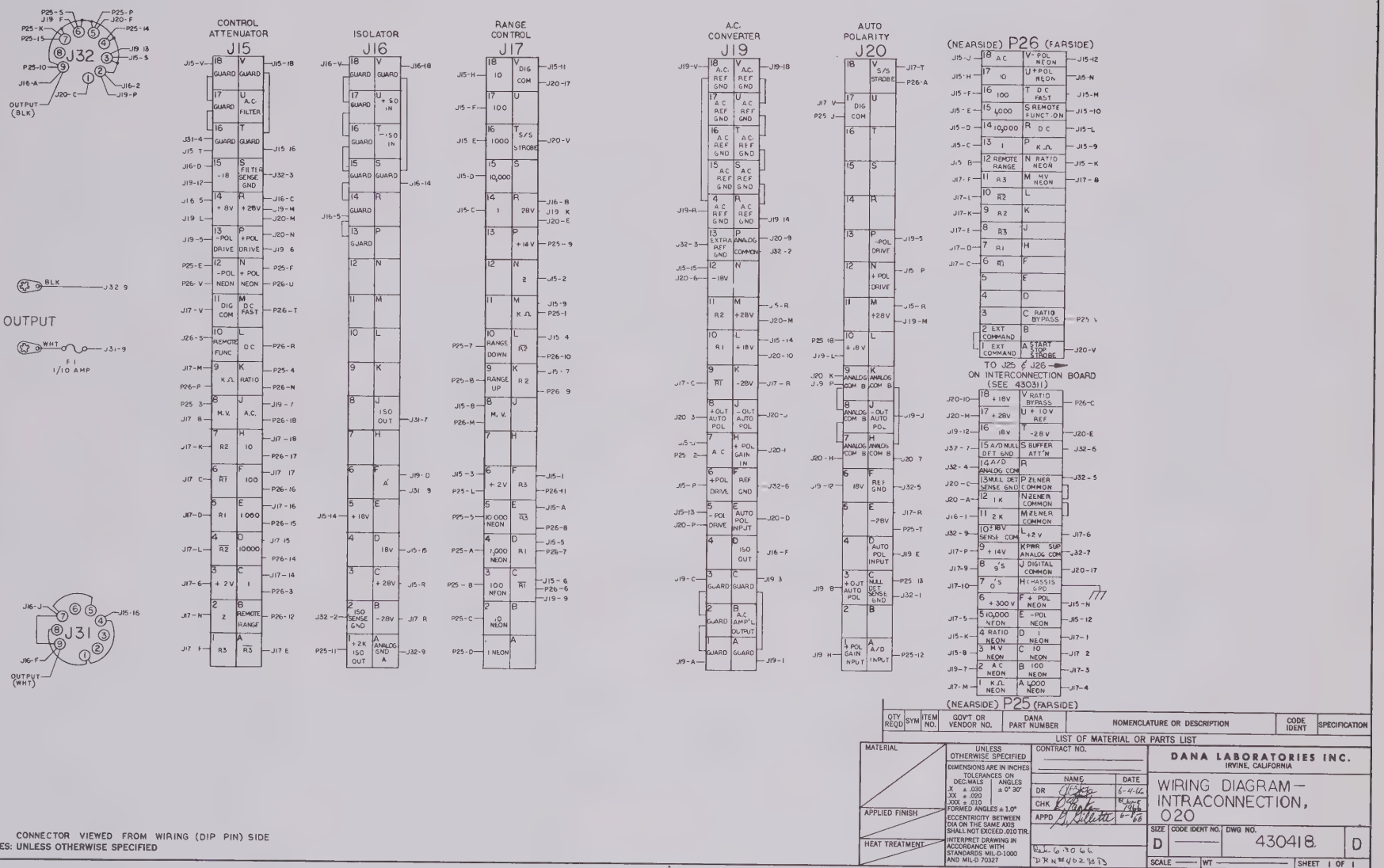
Rel 6-10-66
DRN # 419 B

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM - INTRACONNECTION, 5400 DVM, BCD

SIZE	CODE IDENT NO.	DWG NO.	
D	—	430362	A

SCALE — WT — SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D 70327

CONTRACT NO.

	NAME	DATE
DR		6-4-66
CHK		6-7-66
APPD		6-7-66

Rel. 6-30-66
DANA 602-75-13

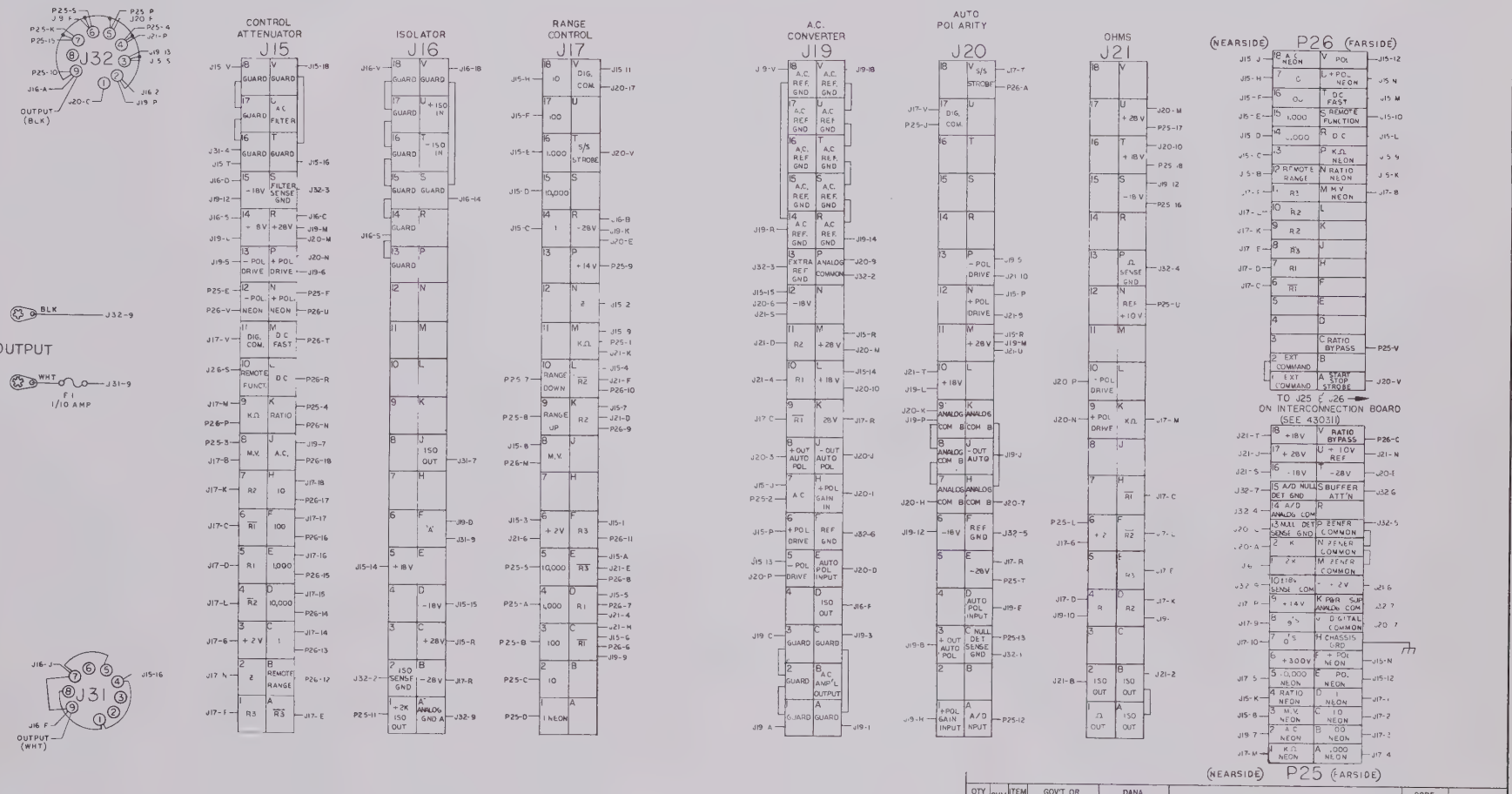
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM — INTRACONNECTION, 020

SIZE	CODE IDENT NO.	DWG NO.	
D		430418	D

SCALE — WT — SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. CONNECTOR VIEWED FROM WIRING (DIP PIN) SIDE



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		
CHK		8 JUNE 66
APPD		6-8-66

REL 6-24-66
DRN 4447 BD

DANA LABORATORIES INC
IRVINE, CALIFORNIA

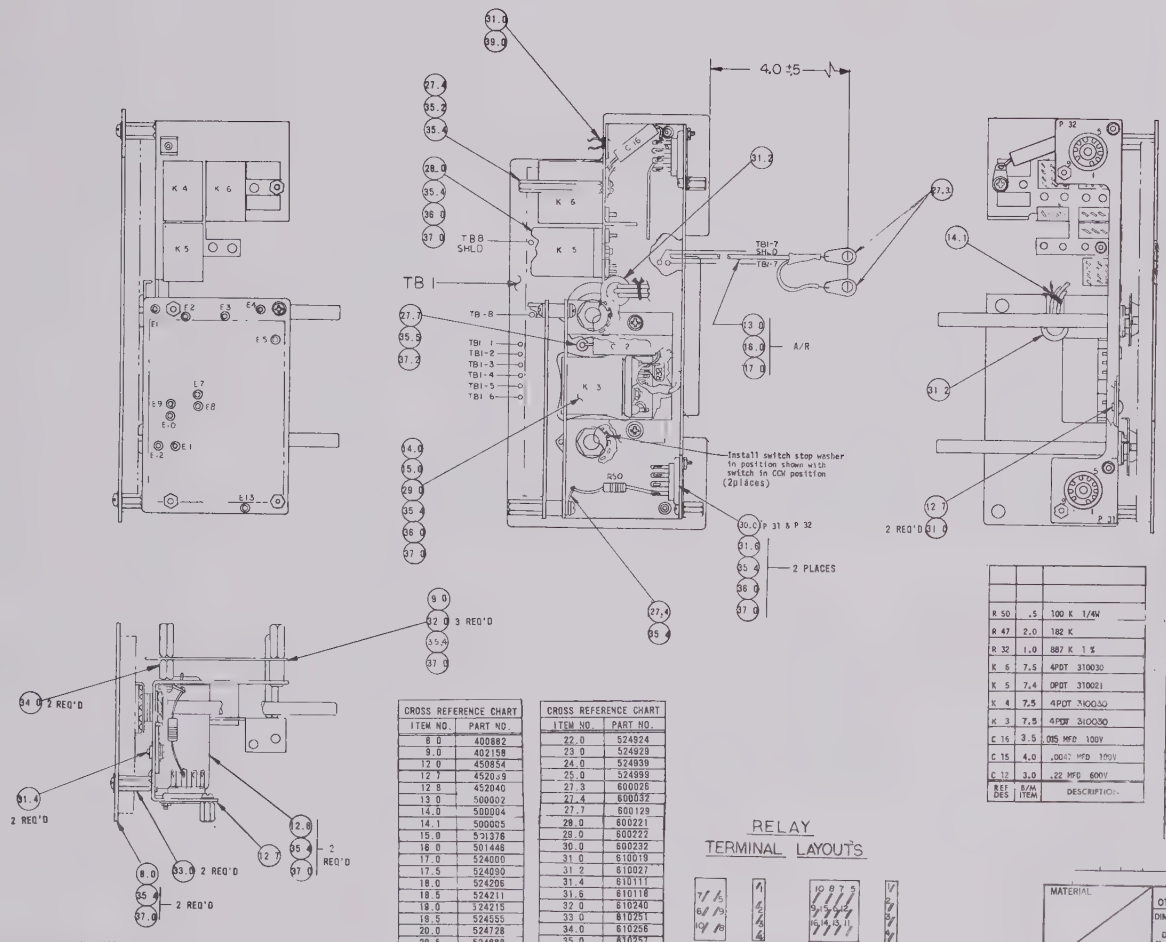
WIRING DIAGRAM - INTRACONNECTION, 030

SIZE	CODE IDENT NO.	DWG NO	
D	—	430419	D

SCALE — WT — SHEET 1 OF 1

L CONNECTORS VIEWED FROM WIRING (DIP PIN) SIDE.

NOTES: UNLESS OTHERWISE SPECIFIED



FROM	TO	CONDUCTOR USED; COLOR	B/W ITEM NO.	WIRE LENGTH	NOTES
P32-1	P32-2	BUSS WIRE	14.0		
P32-2	P32-3	BUSS WIRE	14.0		
P32-3	LUG	C18 .05UF/100V	3.5 & 15.0		
P32-3	P32-4	BUSS WIRE	14.0		LEADS SLEEVED A/R
P32-4	P32-5	BUSS WIRE	14.0		
P32-5	P32 8	BUSS WIRE	14.0		
P32-8	P32-7	BUSS WIRE	14.0		
P32 7	P32 9	SLEEVED BUSS WIRE	14.0&15.0		
TB1-2	K4-6	9-2	23.0		Via Grommet (Item 31.2
TB1-3	K3-7	9-3	24.0		
TB1-4	K5-4	9-1-5	20.7		
TB1-5	K5-1	5	19.5		
TB1-6	K6-4	9-1-6	21.0		
TB1-7	K3-8	RG174/U	16.0		
Shld to TB1-7 Shld	Shld not conn.	0	17.0 and 13.0		Tubing as Req'd
TB1-8	K6-9	RG174/U	16.0		
Shld to TB1-8 Shld	Shld not conn.	0	17.0 and 13.0		Via Grommet (Item 31.2 Tubing as Req'd
E-1	K5-10	8	20.9		
E-1	K5-5	9-1	21.9		
E- 2	K5-7	0	17.0		
E- 3	K6-14	2-1-1	18.5		
E- 4	K5-9	9-1-3	20.8		
E-9	K4-12	9-1-4	21.3		
E-7	K4-16	9-1-8	21.8		
E-5	K4-1	9-1-7	21.2		
E-13	P31-4	2-1-5	19.0		
E-?	P32	5 1 5	19.0		
E-10	P31-7	7-2-8	20.0		
K3-6	K4-1	9-1	21.9		
K3-14	K4-15	Sleeved Buss Wire	14.0 &15.0		
K3-11	K4-9	Sleeved Buss Wire	14.0 &15.0		
K3-9	K4-12	Sleeved Buss Wire	14.0 &15.0		
K2-13	K6-5	RG174/U	16.0		
Shld not conn.	Shld to conn.	0	17.0 and 13.0		Tubing as Req'd
K3-10	P32-8	C12, .22UF/600V	3.0 &15.0		Leads Sleeved as Req'd
P31-12	K6-13	RG174/U	16.0		
Shld not conn.	Shld to P31-1	0	17.0 and 13.0		Tubing as Req'd
K3-12	P31-3	RG174/U	16.0		
Shld not conn.	Shld to P31-8	0	17.0 and 13.0		Tubing as Req'd
K3-8	Lug(Item no. 27.3)	RG174/U	16.0		
Shld to P32-9	Shld to Lug(Item no. 27.3)	0	17.0 and 13.0		Tubing as Req'd
K4-7	K6-6	9-2-4	22.0		
K4-14	K6-10	R47, 182 K C15, .0047UF/100V	2.0, 4.0 and 15.0		Resistor wired in parallel with capacitor; Leads sleeved as req'd.
K4-11	K6-7	R32, 887K 1%	1.0 &15.0		Leads Sleeved as Req'd
K4-8	P31-9	0-9	17.5		
K4-10	K5-2	9	20.0		
K5-9	K6-8	RG174/U	16.0		
Shld to P31-6	Shld not conn.	0	17.0 and 13.0		Tubing as Req'd
K5-1	K6-4	0	17.0		
K6-12	P31-2	RG174/U	16.0		
Shld not conn.	Shld to P31-1	0	17.0 and 13.0		Tubing as Req'd
K6-15	P31-5	5	24.0		
K6-8	K6-11	Sleeved Buss Wire	14.0 &15.0		
K6-6	K6-10	Sleeved Buss Wire	14.0 &15.0		
P31-1	Lug(Item no. 27.4)	.5, 100K, 1/4%	.5 & 15.0		Leads Sleeved as Req'd

R 50	.5	100 K 1/4W
R 47	2.0	182 K
R 32	1.0	887 K 1 %
K 6	7.5	4PDT 310030
K 5	7.4	DPDT 310021
K 4	7.5	4PDT 310030
K 3	7.5	4PDT 310030
C 16	3.5	.015 MFD 100V
C 15	4.0	.0047 MFD 100V
C 12	3.0	.22 MFD 600V
REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
8.0	400882
9.0	402158
12.0	450854
12.7	452039
12.8	452040
13.0	500002
14.0	500004
14.1	500005
15.0	501376
16.0	501446
17.0	524000
17.5	524090
18.0	524206
18.5	524211
19.0	524215
19.5	524555
20.0	524728
20.5	524888
20.6	524913
20.7	524915
21.0	524916
21.3	524917
21.8	524918
21.9	524919

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
22.0	524924
23.0	524928
24.0	524939
25.0	524999
27.3	600026
27.4	600032
27.7	600129
28.0	600221
29.0	600222
30.0	600232
31.0	610019
31.2	610027
31.4	610111
31.6	610118
32.0	610240
33.0	610251
34.0	610258
35.0	610257
35.2	610283
35.4	615042
35.5	615056
36.0	617016
37.0	617077
37.2	617078
38.0	620113

RELAY TERMINAL LAYOUTS

NOTES: UNLESS OTHERWISE SPECIFIED

1. WIRING DIAGRAM REFERENCE 430484
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
3. SCHEMATIC REFERENCE: 430464

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.030, XX ±.020, XXX ±.010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	11 MAR 1966
CHK	Toff	24 MAR 66
APPD	[illegible]	4/4/66

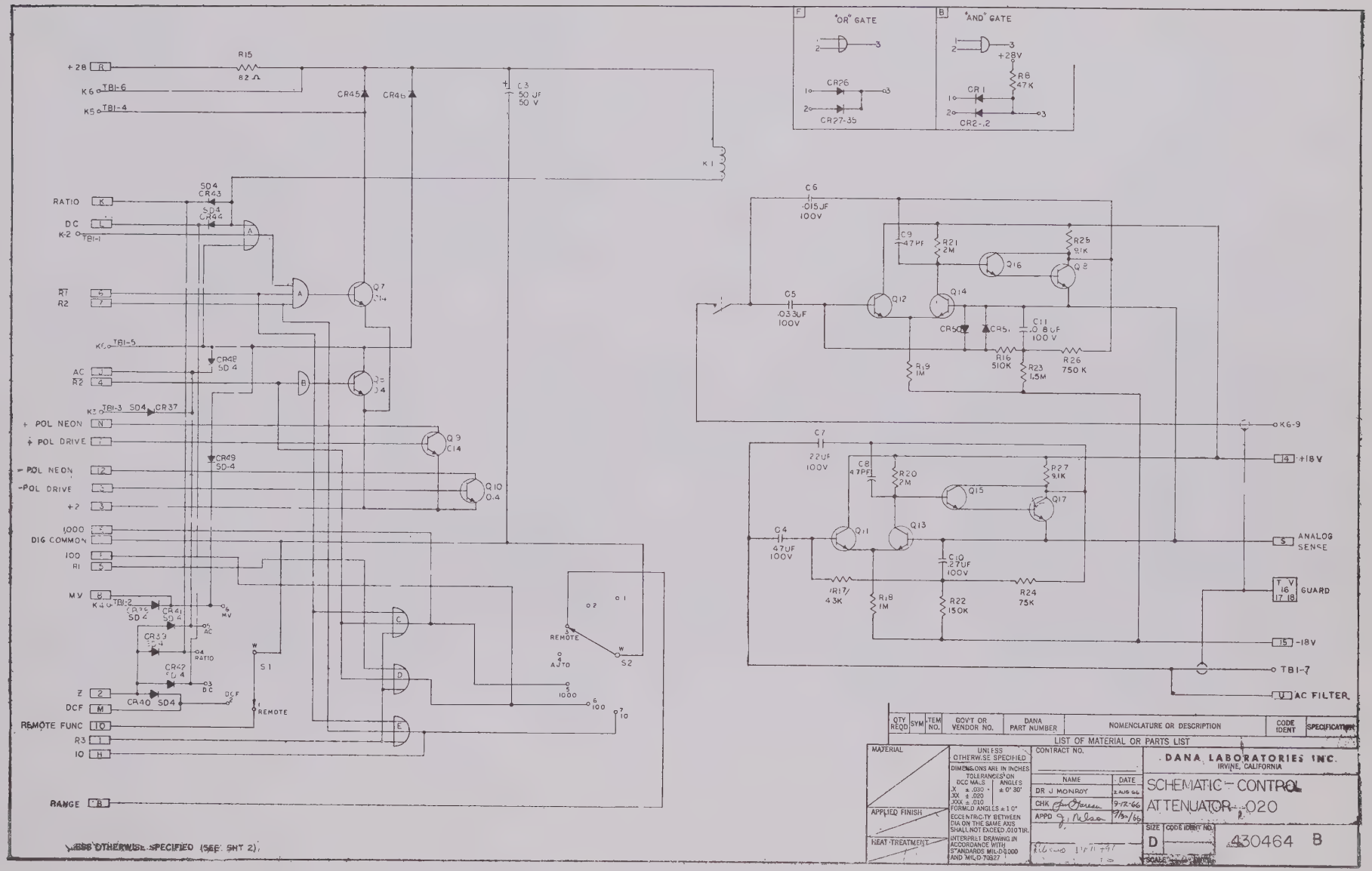
Rel. 6-30-66
DRN #US7838

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ATTENUATOR & CONTROL ASSY - 020

SIZE D | CODE IDENT NO. | DWG NO. 400858 | L

SCALE 1/1 | WT | SHEET 1 OF 1



UNLESS OTHERWISE SPECIFIED (SEE SHT 2).

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DEC MAS | ANGLES
X ± .030 | ± 0° 30'
XX ± .020
XXX ± .010
FORMLD ANGLES ± 1 0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-3000 AND MIL-D 70327

CONTRACT NO.

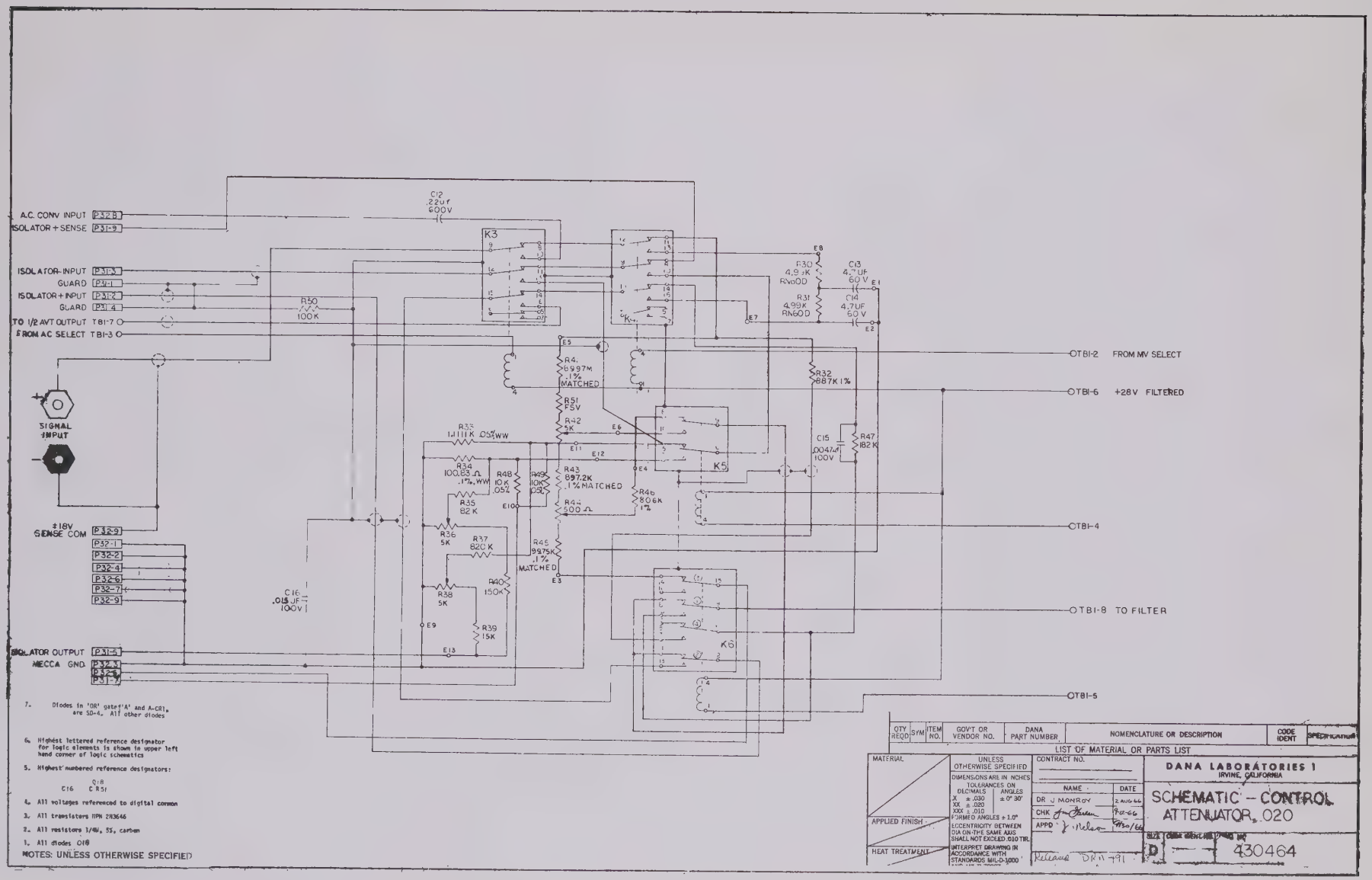
	NAME	DATE
DR	J MONROY	2 AUG 66
CHK		9-12-66
APPD	J. Nelson	7/9/66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — CONTROL ATTENUATOR - 020

SIZE	CODE IDENT NO.	430464 B
D		

SCALE



7. Diodes in 'OR' gate 'A' and A-CR1, are SD-4. All other diodes

6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics

5. Highest numbered reference designators:

Q18	C16	CR51

4. All voltages referenced to digital common

3. All transistors NPN 2N3646

2. All resistors 1/4W, 5%, carbon

1. All diodes D18

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.030, XX ±.020, XXX ±.010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000

CONTRACT NO.

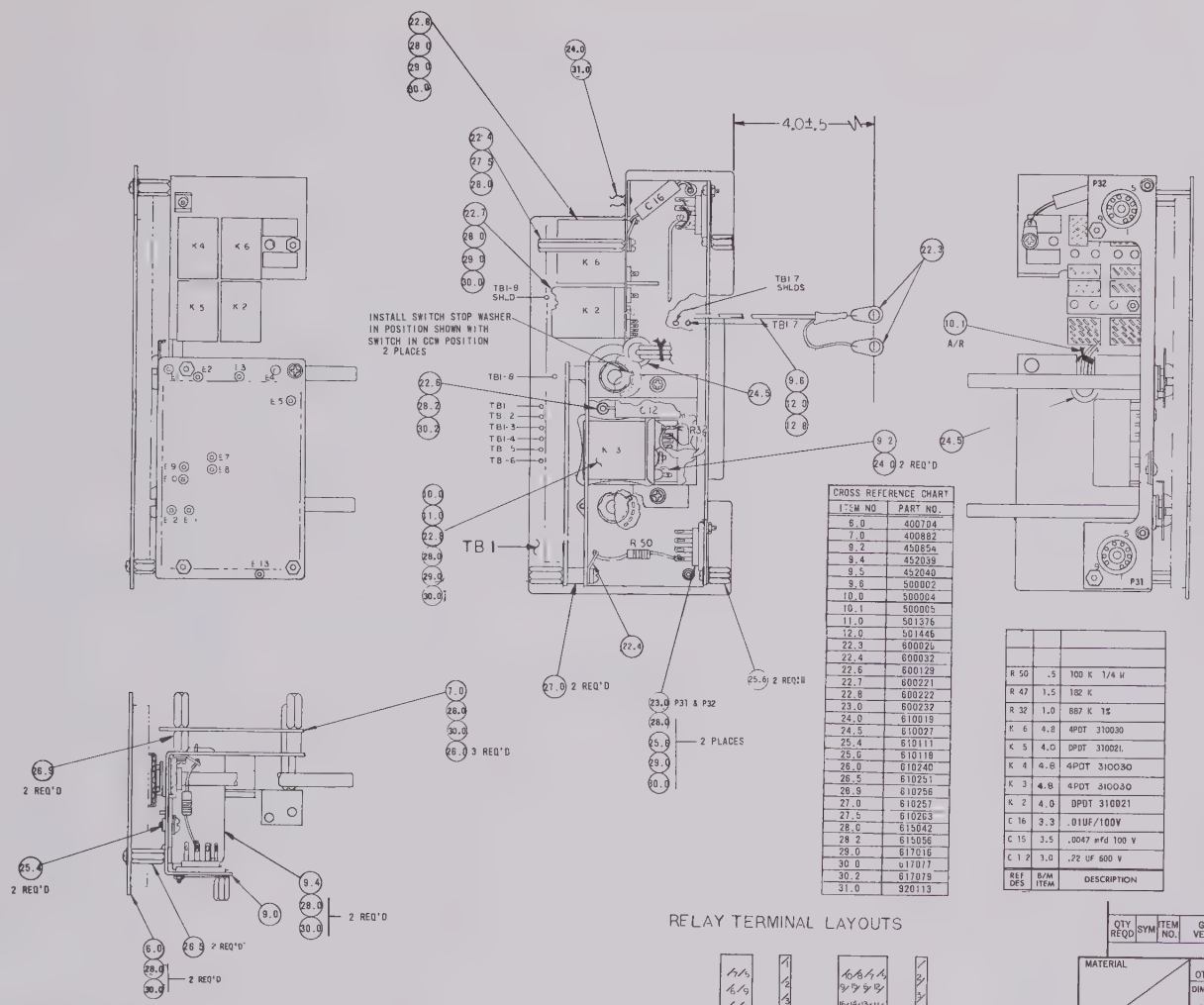
	NAME	DATE
DR	J MONROY	2 AUG 66
CHK		8-2-66
APPD		8/30/66

Released DRN 491

DANA LABORATORIES 1
IRVINE, CALIFORNIA

SCHEMATIC - CONTROL ATTENUATOR .020

SIZE D — 430464

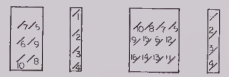


CROSS REFERENCE CHART	
ITEM NO	PART NO.
6.0	400704
7.0	400882
9.2	450854
9.4	452039
9.5	452040
9.8	500002
10.0	500004
10.1	500005
11.0	501376
12.0	501446
22.3	600026
22.4	600032
22.6	600129
22.7	600221
22.8	600222
23.0	600232
24.0	610018
24.5	610027
25.4	610111
25.6	610118
26.0	610240
26.5	610251
26.9	610258
27.0	610257
27.5	610263
28.0	615042
28 2	615056
29.0	617016
30 0	617017
30.2	617079
31.0	920113

R 50	.5	100 K 1/4 W
R 47	1.5	182 K
R 32	1.0	887 K 1%
K 6	4.8	4PDT 310030
K 5	4.0	DPDT 310021
K 4	4.8	4PDT 310030
K 3	4.8	4PDT 310030
K 2	4.0	DPDT 310021
C 16	3.3	.01UF/100V
C 15	3.5	.0047 mfd 100 V
C 12	3.0	.22 UF 600 V
REF DES	B/M ITEM	DESCRIPTION

FROM	TO	CONDUCTOR USED; COLOR	B/M ITEM NO.	WIRE LENGTH	NOTES
P32-2	P32-3	BUSS WIRE	10.0		
P32-3	LUG	C18, .015UF/100V	3.5 & 11.0		LEADS SLEEVED A/R
P32-3	P32-4	BUSS WIRE	10.0		
P32 4	P32-5	BUSS WIRE	10.0		
P32-5	P32 6	BUSS WIRE	10.0		
P32-6	P32 7	BUSS WIRE	10.0		
P32-7	P32-9	SLEEVED BUSS WIRE	10.0 & 11.0		
TB1-1	K2-4	9-1-2	16.0		VIA GROMMET (ITEM 24.5)
TB1-2	K4-4	9-2	20.0		
TB1-3	K3-1	9-3	20.5		
TB1-4	K5-4	9-1-5	17.0		
TB1-5	K6-1	5	14.5		
TB1-6	K6-4	9-1-6	17.5		
TB1-7	K3-16	RG174/U	12.0		
Shld to TB1-7 Shld	Shld not conn.	0	12.8 ± 9.6		TUBING AS REQ'D
TB1-8	K6-9	RG174/U	12.0		
Shld to TB1-8 Shld	Shld not conn.	0	12.8 ± 9.6		VIA GROMMET (ITEM 24.5) TUBING AS REQUIRED
E-1	K5-10	8	15.5		
E-11	K5-5	9-1	19.0		
E-12	K5-7	9	12.8		
E-3	K6-14	2-1-1	13.5		
E-4	K5-8	9-1-3	16.5		
E-9	K4-11	9-16	13.0		
E-7	K4-12	2-1-6	18.5		
E-5	K4-11	9-1-7	18.0		
E-13	P31-5	2-1-5	14.0		
E-2	K2-8	2-1-5	14.0		
E-10	P31-7	7-2-8	15.9		
K2-1	K2-4	9-1-3	16.3		VIA GROMMET (ITEM 24.5
K2-8	P32-3	9-1-2	16.0		
K2-6	Lug(Item no. 22.1)	RG174/U	12.0		
Shld to K2-9	Shld to Lug(Item no. 22.1)	0	12.8 ± 9.6		TUBING AS REQ'D
K2-7	P31-6	RG174/U	12.0		
Shld not conn.	Shld to P31-7	0	12.8 ± 9.6		TUBING AS REQ'D
K2-9	P32-1	9-1-5	17.0		VIA GROMMET (ITEM 24.5
K3-4	K4-1	9-1	19.0		
K3-14	K4-15	Sleeved Buss wire	10.0 & 11.0		
K3-11	K4-9	Sleeved Buss wire	10.0 & 11.0		
K3-8	K4-12	Sleeved Buss wire	10.0 & 11.0		
K3-13	K5-8	RG174/U	12.0		
Shld not conn.	Shld to P31-1	0	12.8 ± 9.6		TUBING AS REQUIRED
K3-10	P32-8	C12, .22UF/ 600V	3.0 & 11.0		Leads Sleeved As Req'd
K3-15	K6-13	RG174/U	12.0		
Shld not conn.	Shld to P31-4	0	12.8 ± 9.6		TUBING AS REQUIRED
K3-12	P31-3	RG174/U	12.0		
Shld not conn.	Shld to P31-4	0	12.8 ± 9.6		TUBING AS REQUIRED
K3-9	Lug(Item no. 22.3)	RG174/U	12.0		
Shld to P32-9	Shld to Lug(Item no.22.3)	0	12.8 ± 9.6		TUBING AS REQUIRED
K4-1	K6-4	9-2-4	19.5		
K4-14	K6-10	R47, 182K F1%, .0047UF/100V	1.5 & 11.0 3.5		Resistor wired in parallel with capacitor; Leads sleeved as req'd.
K4-11	K6-7	R32, 887K .1%	1.0 & 11.0		Leads Sleeved As Req'd
K4-8	P31-9	D-9	12.9		
K4-10	K 5-6	9	22.1		
K5-9	K6-8	RG174/U	12.0		
Shld to P31-4	Shld not conn.	0	12.8 ± 9.6		TUBING AS REQUIRED
K5-1	K6-4	0	12.8		
K6-12	P31-2	RG174/U	12.0		
Shld not conn.	Shld to P31-1	0	12.8 ± 9.6		TUBING AS REQUIRED
K6-15	P32-5	9	22.1		
K6-8	K6-11	Sleeved Buss Wire	10.0 & 11.0		
K6-6	K6-10	Sleeved Buss Wire	10.0 & 11.0		
P31-1	Lug(Item no. 22.4)	R50, 100K, 1/4 W	.5 & 11.0		Leads Sleeved As Req'd

RELAY TERMINAL LAYOUTS



K2, K5 K3, K4, K6

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED

1. WIRING DIAGRAM REFERENCE 430310
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. SCHEMATIC REFERENCE: 430310

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS | ANGLES
.X ± .030 | ± 0° 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR W. Eche	Nov 1965
CHK T Toft	2 Apr 1966
APPD	

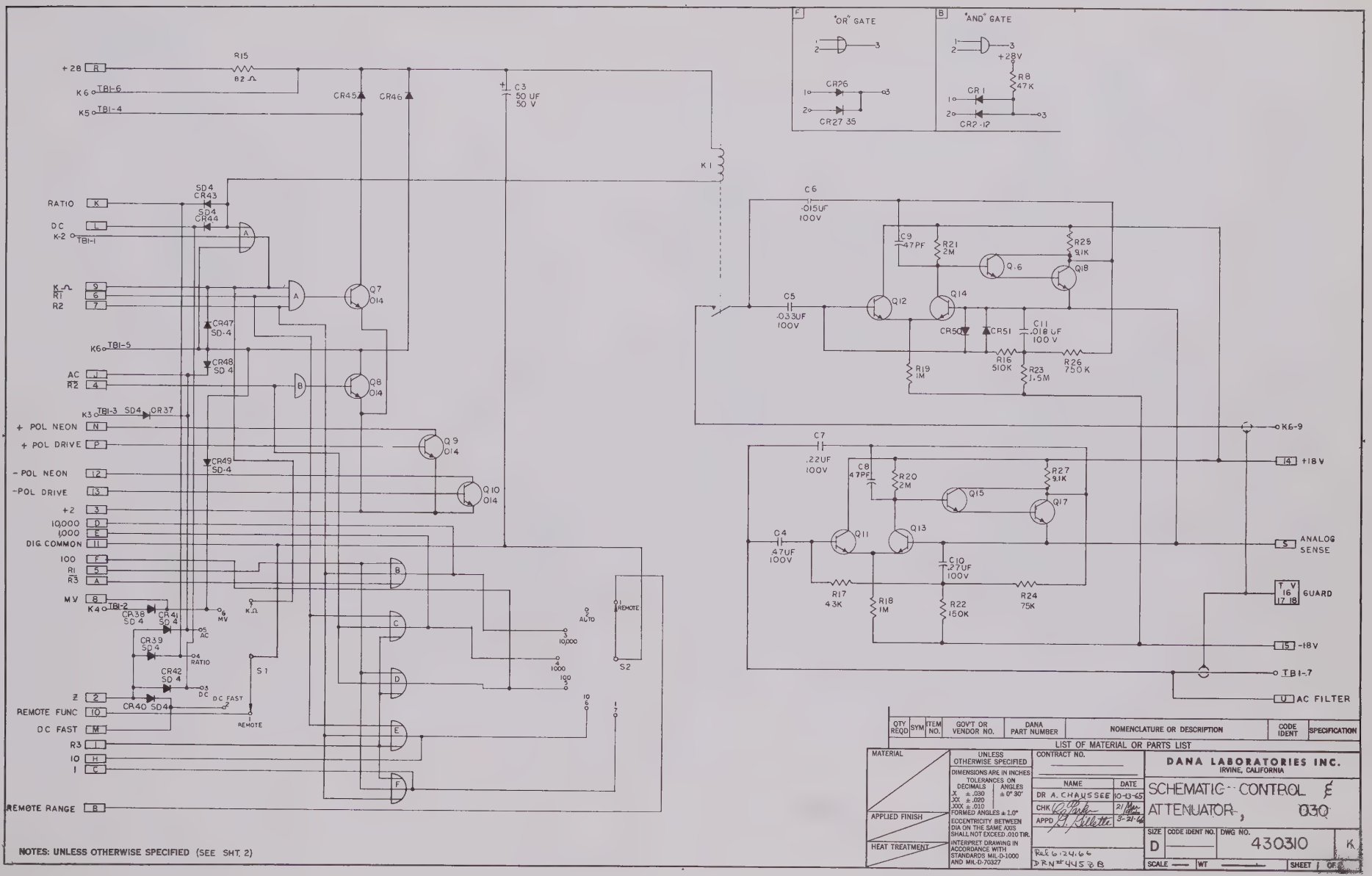
Rev 6.24.66
Added qty + 2

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ATTENUATOR & CONTROL ASS'Y - MULTIMETER (030)

SIZE	CODE IDENT NO.	DWG NO.	
D	——	400698	N

SCALE 1/1 WT —— SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	A. CHAUSSEE	10-13-65
CHK	C. Clark	2/ Nov 3-21-66
APPD	A. Billette	

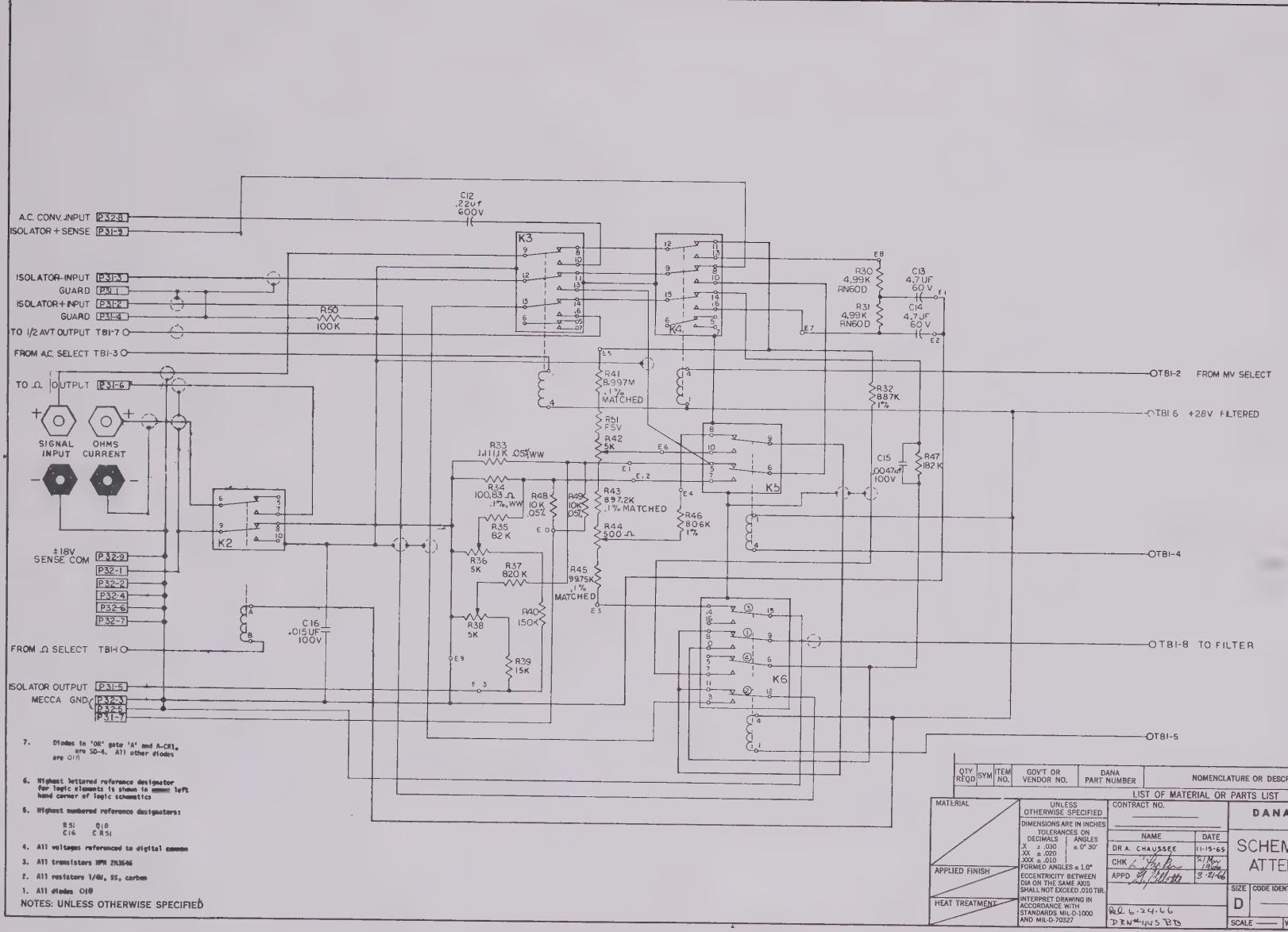
Rel 6.24.66
DRN #4538

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - CONTROL & ATTENUATOR, 030

SIZE	CODE IDENT NO.	DWG NO.	
D		430310	K

SCALE — | WT — | SHEET 1 OF



7. Diodes in 'OR' gate 'A' and A-CR1, are SD-4. All other diodes are 018

6. Highest lettered reference designator for logic elements is shown in ____ left hand corner of logic schematics

5. Highest numbered reference designators:

R51	Q18
C16	CR51

4. All voltages referenced to digital common

3. All transistors MPN 2N3646

2. All resistors 1/4W, 5%, carbon

1. All diodes 018

NOTES: UNLESS OTHERWISE SPECIFIED

LIST OF MATERIAL OR PARTS LIST

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

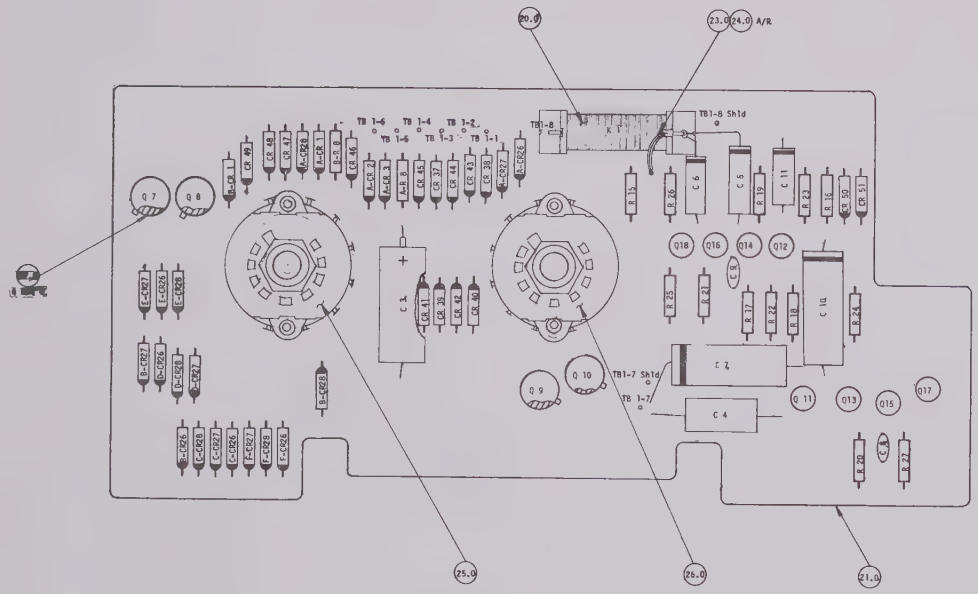
	NAME	DATE
DR	A. CHAUSSEE	11-15-65
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC – CONTROL & ATTENUATOR, 030

SIZE	CODE IDENT NO.	DWG NO.	
D	—	430310	K

SCALE — WT — SHEET 2 OF 2



REF DES	B/M ITEM	DESCRIPTION
CR45	19.0	O18
CR44	18.0	SD 4
Thru		
CR37	18.0	SD 4
CR28	19.0	O18
A-CR28	18.0	SD 4
CR27	19.0	O18
A-CR27	18.0	SD 4
CR26	19.0	O18
A-CR26	18.0	SD 4
CR 4	19.0	O18
CR 3	19.0	O18
B-CR1	18.0	O18
A-CR2	18.0	O18
A-CR1	18.0	SD 4
C 11	12.0	.018 uf/100V
C 10	12.1	.27 uf / 100 V
C 9	10.0	47 pf DISC
C 8	10.0	47 pf DISC
C 7	15.0	.22 MFD 100 V
C 6	13.0	.015 MFD 100 V
C 5	14.0	.033 MFD 100 V
C 4	11.5	.47 MFD 100 V
C 3	11.5	50 MFD 50 V

REF DES	B/M ITEM	DESCRIPTION
Q 18	16.0	2N3565
Thru		
Q 11	16.0	2N3565
Q 10	15.7	O14
Q 7	15.7	O14
R 27	8.0	9.1 K
R 26	6.6	750 K
R 25	8.0	9.1 K
R 24	6.5	75 K
R 23	3.0	1.5 MEG
R 22	2.9	150 K
R 21	4.0	2 Meg
R 20	4.0	2 Meg
R 19	1.0	1 Meg
R 18	1.0	1 Meg
R 17	5.0	43 K
R 16	6.0	510 K
R 15	7.0	82 ohms
R 8	5.5	47K
CR 51	19.0	O18
CR 50	19.0	O18
CR 49	18.0	SD 4
CR 47	18.0	SD 4
CR 46	19.0	O18

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
20.0	330113A
21.0	410163 H
23.0	500004
24.0	501376
25.0	600218
26.0	600236
27.0	920006

3. SCHEMATIC REFERENCE: 430310
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
1. All resistors 1/4W, 5%, Carbon.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	11-13-65
CHK	WATSON	11-10-65
APPD	[illegible]	11/16/65

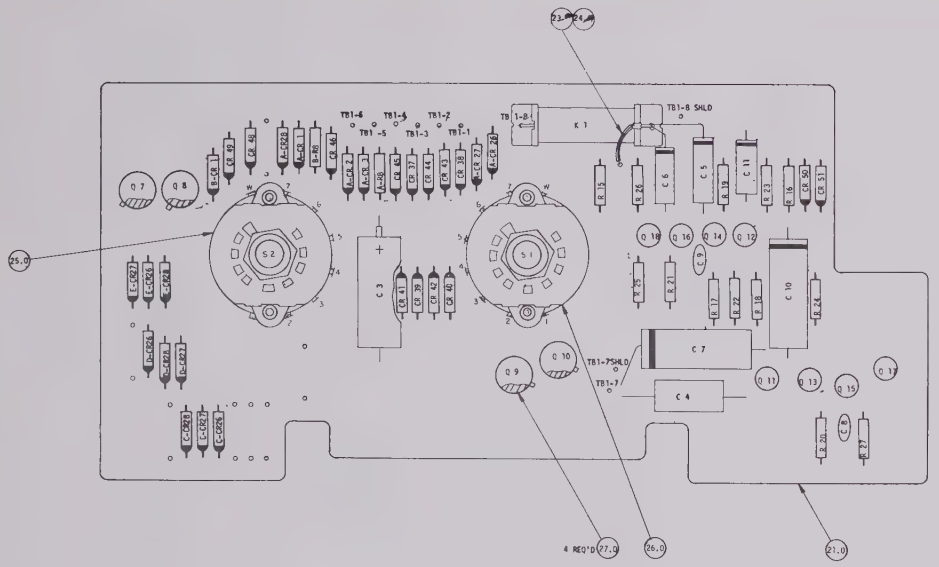
Rev. 11-19-65
DBN # 305

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY - SWITCH PANEL, 030

SIZE D | CODE IDENT NO. | DWG NO. 400704 | F

SCALE 2:1 | WT | SHEET 1 OF 1



CR 46	19.0	018	Q 18	17.0	2N3565
CR 45	19.0	018	thru		
CR 44	18.0	SD4			
thru			Q 11	17.0	2N3565
			Q 10	16.0	014
CR 37	18.0	SD4			
			Q 7	16.0	014
CR 28	19.0	018			
A-CR28	18.0	SD4	R 27	8.0	9.1 K
CR 27	19.0	018	R 26	6.6	750K
A-CR27	18.0	SD4	R 25	8.0	9.1 K
CR 26	19.0	018	R 24	6.5	75K
A-CR26	18.0	SD4	R 23	7.1	1.5 MEG
			R 22	2.0	150K
CR 4	19.0	018	R 21	3.0	2 MEG
CR 3	19.0	018	R 20	3.0	2 MEG
			R 19	1.0	1 MEG
B-CR1	19.0	018	R 18	1.0	1 MEG
A-CR2	19.0	018	R 17	4.0	43 K
A-CR1	18.0	SD4	R 16	6.0	510 K
			R 15	7.0	82 OHMS
			R 8	5.0	47 K
C 11	12.5	.018 MFD 100 V			
C 10	12.6	.27 MFD 100 V			
C 9	10.0	47 PF DISC	K 1	20.0	RELAY 310013
C 8	10.0	47 PF DISC			
C 7	14.0	.22 MFD 100 V			
C 6	13.5	.015 MFD 100 V	CR 51	19.0	018
C 5	15.0	.033 MFD 100 V	CR 50	19.0	018
C 4	12.3	.47 MFD 100 V	CR 49	18.0	SD4
C 3	11.0	50 MFD 50 V	CR 48	18.0	SD4
REF DES	B/M ITEM	DESCRIPTION	REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
21.0	4 D286A
23.0	500004
24.0	501376
25.0	500218
26.0	500236
27.0	920006

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR J MONROY	2 AUG 66
CHK	9-12-1966
APPD	9-13-66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — SWITCH PANEL , 020

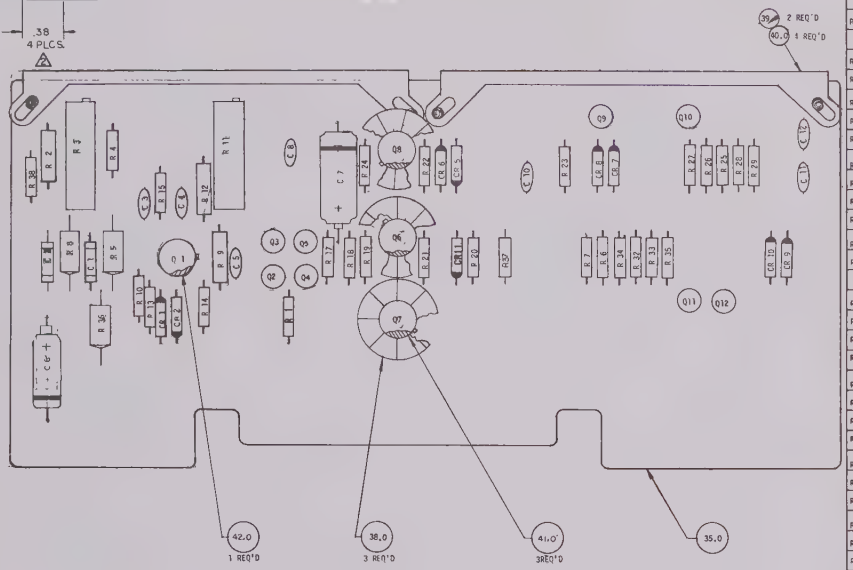
SIZE	CODE IDENT NO.	DWG NO.
D		402158 C

SCALE 2/1 | WT | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. All resistors 1/4w, 5%, Carbon.
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. SCHEMATIC REFERENCE. 430464

AUTO POLARITY 402056 SERIAL NO [redacted] DANA



REF DES	B/M ITEM	DESCRIPTION
P 29	3.0	15 K
R 27	3.0	15 K
R 26	5.0	18 K
R 25	3.0	15 K
R 24	13.0	47 ohms
R 23	7.0	200 ohms
R 22	2.0	10 K
R 21	15.0	91 ohms
R 20	14.0	4.7 K
R 19	15.0	91 ohms
R 18	14.0	4.7 K
R 17	1.0	1 K
R 15	1.0	1 K
R 14	6.0	180 K
R 13	6.0	180 K
R 12	16.0	422 K (1%)
R 11	20.0	50 K (POT.)
R 10	1.0	1 K
R 9	16.0	422 K (1%)
R 8	18.0	10 K (.05%)
R 7	9.0	24 K
R 6	9.0	24 K
R 5	18.0	10 K (.05%)
R 4	12.0	39 K
R 3	19.0	5 K (POT.)
R 2	17.0	100 ohms (1%)
R 1	8.0	2 K

REF DES	B/M ITEM	DESCRIPTION
C 8	22.0	100 pf
C 7	23.0	25 MFD 50V
C 6	24.0	5 MFD 50 V
C 5	22.0	100 pf
C 4	22.0	100 pf
C 3	22.0	100 pf
C 2	26.0	24 pf
C 1	26.0	24 pf
CR 11	34.0	1/4 M24 AZ5
CR10	33.0	018
CR 7	33.0	018
CR 6	32.0	GE 5368
CR 5	32.0	GE 5368
CR 4	38.0	018
CR 1	33.0	018
R38	9.0	27 K
R 37	11.0	390 OHMS
R 36	18.0	10 K (.05%)
R 35	10.0	30 K
R 34	4.0	16 K
R 33	10.0	30 K
R 32	4.0	16 K

REF DES	B/M ITEM	DESCRIPTION
Q 12	29.0	2N3646
Q 11	29.0	2N3646
Q 10	31.0	2N3565
Q 9	33.0	2N3565
Q 8	28.0	014
Q 7	28.0	014
Q 6	27.0	009
Q 5	29.0	2N3646
Q 4	29.0	2N3646
Q 3	31.0	2N3565
Q 2	31.0	2N3565
Q 1	31.5	016 SELECTED
C 12	21.0	330 pf
C 11	21.0	330 pf
C 10	22.0	100 pf

CROSS REFERENCE CHART	
ITEM NO	PART NO.
35.0	410246 15
38.0	600016
39.0	610236
40.0	610237
41.0	920006
42.0	920082

4 SCHEMATIC REFERENCE: 430415

B ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

A1 Mot stamp .10 high black characters and .15 high logo, located as shown.

2. .031 resistors are 1/4W, 5% tolerance.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR [illegible]	6 June 1966
CHK [illegible]	June 1966
APPD [illegible]	6/9/66

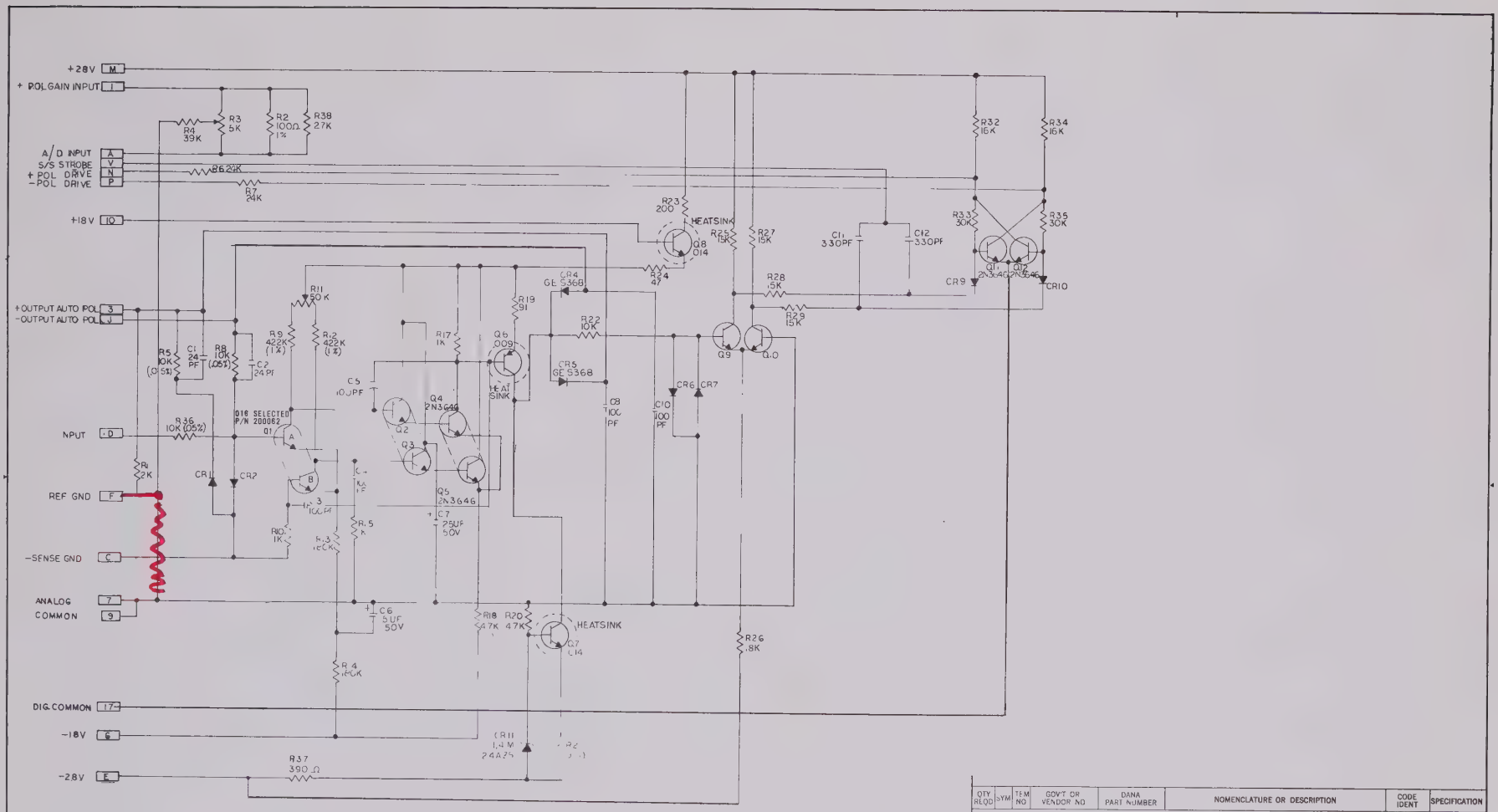
Rel 6.22.66
DRN BY [illegible]

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y -
AUTO POLARITY

SIZE	CODE IDENT NO.	DWG NO.	
D	[redacted]	402056	H

SCALE [redacted] WT [redacted] SHEET 1 OF 1



5. Highest numbered reference designators
   R38 Q12
   C12 CR11
4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 018

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO	GOVT OR VENDOR NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	4-4-66
CHK	[illegible]	9 June 1966
APPD	[illegible]	6/14/66

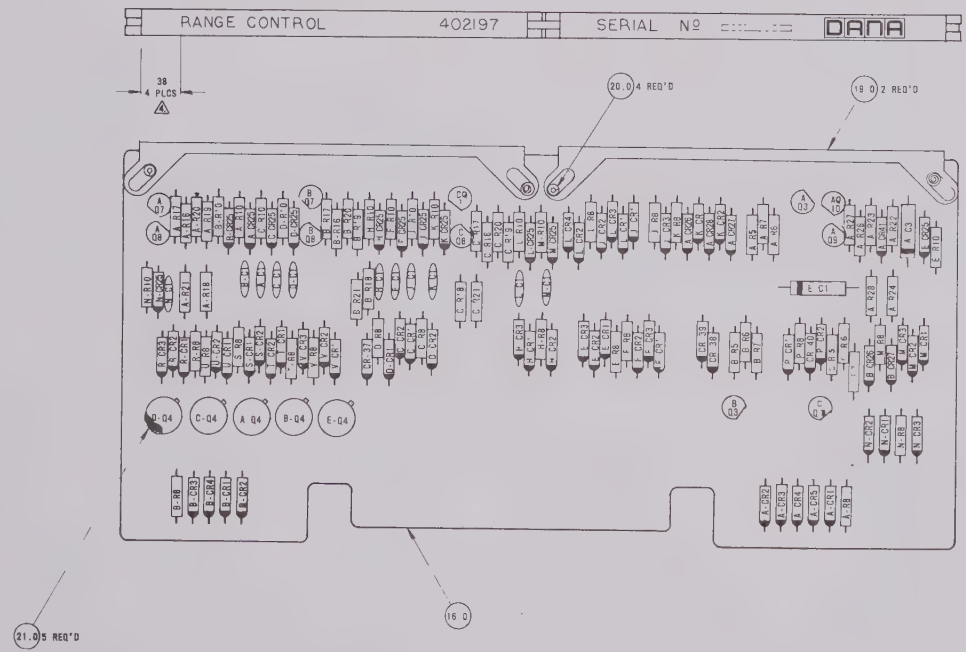
Rel 6-22-66
DANA 940 BB

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
AUTO POLARITY

SIZE	CODE IDENT NO.	DWG NO.	
D	——	430415	C

SCALE —— WT —— SHEET 1 OF 1



REF DES	B/M ITEM	DESCRIPTION
Q 11	13.0	2N3565
Q 7	13.0	2N3565
Q 4	12.0	014
Q 3	13.0	2N3565
CR41	15.0	018
CR40	14.0	SD4
CR39	14.0	SD4
CR38	14.0	SD4
CR37	14.0	SD4
CR28	15.0	018
CR27	15.0	018
CR26	15.0	018
CR25	15.0	018
MCR3	14.0	SD4
PCR2	14.0	SD4
LCR2	14.0	SD4
KCR2	14.0	SD4
BCR2	14.0	SD4
ACR5	14.0	SD4
ACR1	14.0	SD4
CR 4	15.0	018
CR 3	15.0	018
CR 2	15.0	018
CR 1	15.0	018
C 3	11.0	0022 UF / 100V
E-C1	11.0	0022 UF / 100V
C 1	10.0	001 UF DISC

REF DES	B/M ITEM	DESCRIPTION
P-R8	9.0	8.2K
M-R8	9.0	8.2K
L-R8	9.0	8.2K
K-R8	9.0	8.2K
J-R8	9.0	8.2K
F-R8	8.0	5.1K
E-R8	8.0	5.1K
D-R8	2.0	12 K
C-R8	2.0	12 K
R 28	8.0	5.1K
R 27	3.0	15K
R 26	9.0	8.2K
R 24	1.0	100K
R 23	9.0	8.2K
R 22	5.0	24K
R 21	8.0	5.1K
R 20	3.0	15K
R 19	5.0	2.2K
R 18	8.0	5.1K
R 17	3.0	15K
R 16	5.0	2.2K
R 10	7.0	27K
R 8	8.0	24K
R 7	4.0	200K
R 8	3.0	15K
R 5	9.0	8.2K

CROSS REFERENCE CHART	
ITEM NO	PART NO
16.0	410300 15
19.0	610236
20.0	610237
21.0	920006

7. SCHEMATIC REFERENCE: 430501
6. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
⚠ COMPONENTS WITH LETTER PREFIX ARE EXCEPTIONS TO STANDARD LOGIC.
⚠ HEAT STAMP. 10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.
3. ALL TRANSISTORS ARE 2N3565.
2. ALL DIODES ARE 018.
1. ALL RESISTORS ARE ¼W, CARBON, ±5%.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .XX ±.03, .XXX ±.010; ANGLES 0° 30'; FORMED ANGLES 1.0
MATERIAL
FINISH

CONTRACT NO.

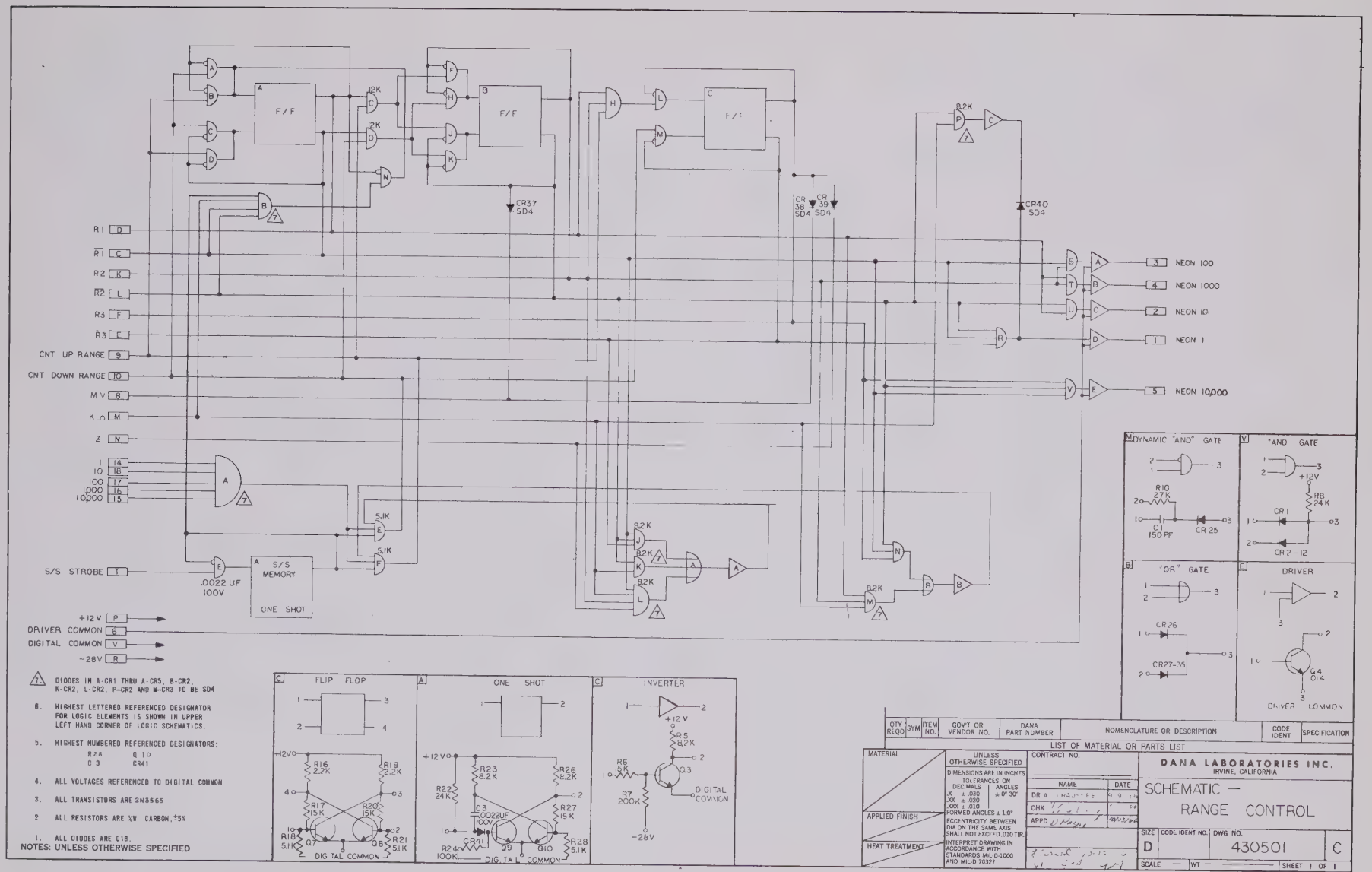
DRAWN	A CHAUSSEE	9.3.66
CHECK	J.E. Salazar	9-7-66
CSG ENGR		
PROJ ENGR	D Payne	10/13/66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y
RANGE CONTROL

SIZE	CODE IDENT NO.	DWG NO.	REV
D		402197	E

SCALE 2:1 WT — SHEET 1 OF 1



1. DIODES IN A-CR1 THRU A-CR5, B-CR2, K-CR2, L-CR2, P-CR2 AND M-CR3 TO BE SD4
6. HIGHEST LETTERED REFERENCED DESIGNATOR FOR LOGIC ELEMENTS IS SHOWN IN UPPER LEFT HAND CORNER OF LOGIC SCHEMATICS.
5. HIGHEST NUMBERED REFERENCED DESIGNATORS:
   R28 Q 10
   C 3 CR41
4. ALL VOLTAGES REFERENCED TO DIGITAL COMMON
3. ALL TRANSISTORS ARE 2N3565
2. ALL RESISTORS ARE ¼W CARBON, ±5%
1. ALL DIODES ARE 018.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D 70327

CONTRACT NO.

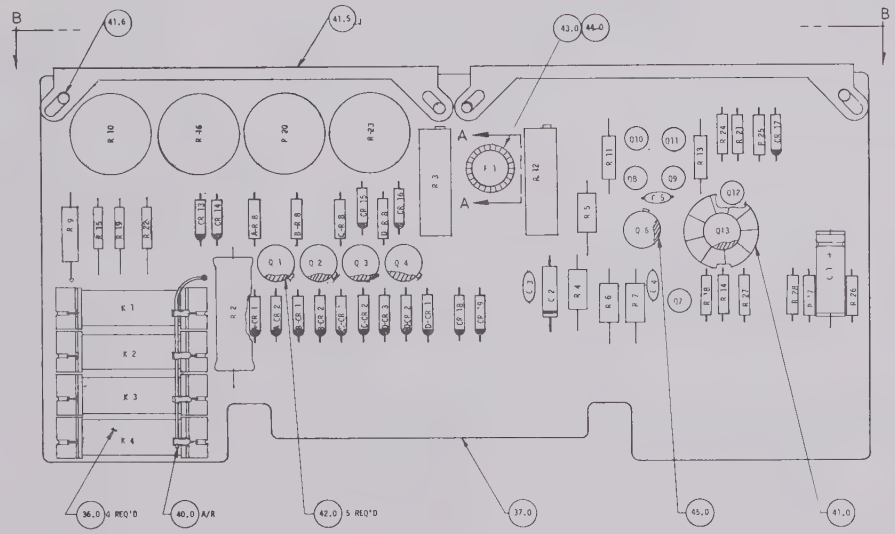
	NAME	DATE
DR A		
CHK		
APPD		

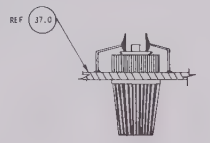
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — RANGE CONTROL

SIZE D | CODE IDENT NO. | DWG NO. 430501 | C

SCALE — | WT | SHEET 1 OF 1





SECTION A A

REF DES	B/M ITEM	DESCRIPTION
Q 4	30.0	D14
Q 1	30.0	D14
CR19	33.0	SD 4
CR18	33.0	SD 4
CR17	35.0	2.4 V 1N4370
CR16	34.0	D18
CR13	34.0	D18
CR 3	34.0	D18
CR 2	34.0	D18
CR 1	34.0	D18
C 5	25.0	100 pf
C 4	26.0	.001 MFD Disc
C 3	26.0	.001 MFD Disc
C 2	28.0	.0047 MFD 100 V
C 1	27.0	1 MFD 50V

REF DES	B/M ITEM	DESCRIPTION
R 20	22.0	50 ohms (POT)
R 19	18.7	5.005K 1%
R 18	4.0	1.5 K
R 17	9.0	62 K
R 16	26.3	500 ohms (POT)
R 15	18.6	50.5 K .1%
R 14	7.0	2.4 K
R 13	13.0	54.9 K 1%
P 12	19.0	10 K (POT)
R 11	13.0	54.9 K 1%
R 10	23.0	5 K (POT)
R 9	13.8	555.5 K .1%
R 8	8.0	47 K
R 7	18.9	10 K .05%
R 6	18.5	5.025 K .05%
R 5	18.5	5.025 K .05%
R 4	18.9	10 K .05%
R 3	24.0	50 K (POT)
R 2	13.7	5 Meg .1%
Q 13	29.0	D09
Q 12	32.0	2N3565
Q 7	32.0	2N3565
Q 6	31.0	D16

REF DES	B/M ITEM	DESCRIPTION
R 28	1.0	10 ohms
R 27	10.0	9.1 K
R 26	2.0	100 ohms
R 25	5.0	16 K
R 24	5.0	16 K
R 23	21.0	5 ohms (POT)
R 22	18.8	500 ohms 1%
R 21	6.0	2 K

OHMS CONVERTER 400705 SERIAL Nº [illegible] DANA

VIEW B-B

.38
4 PLCS
2

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
36.0	310013
37.0	410167F
40.0	500004
41.0	600016
42.0	920006
43.0	920053
44.0	920054
45.0	920082
41.5	610236
41.6	610237

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

2 Heat stamp .10 high black characters and .15 high logo, located as shown.

1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR [illegible]	6-4-65
CHK M.S. CURRY	23 JUNE 65
APPD [illegible]	23 JUNE 65

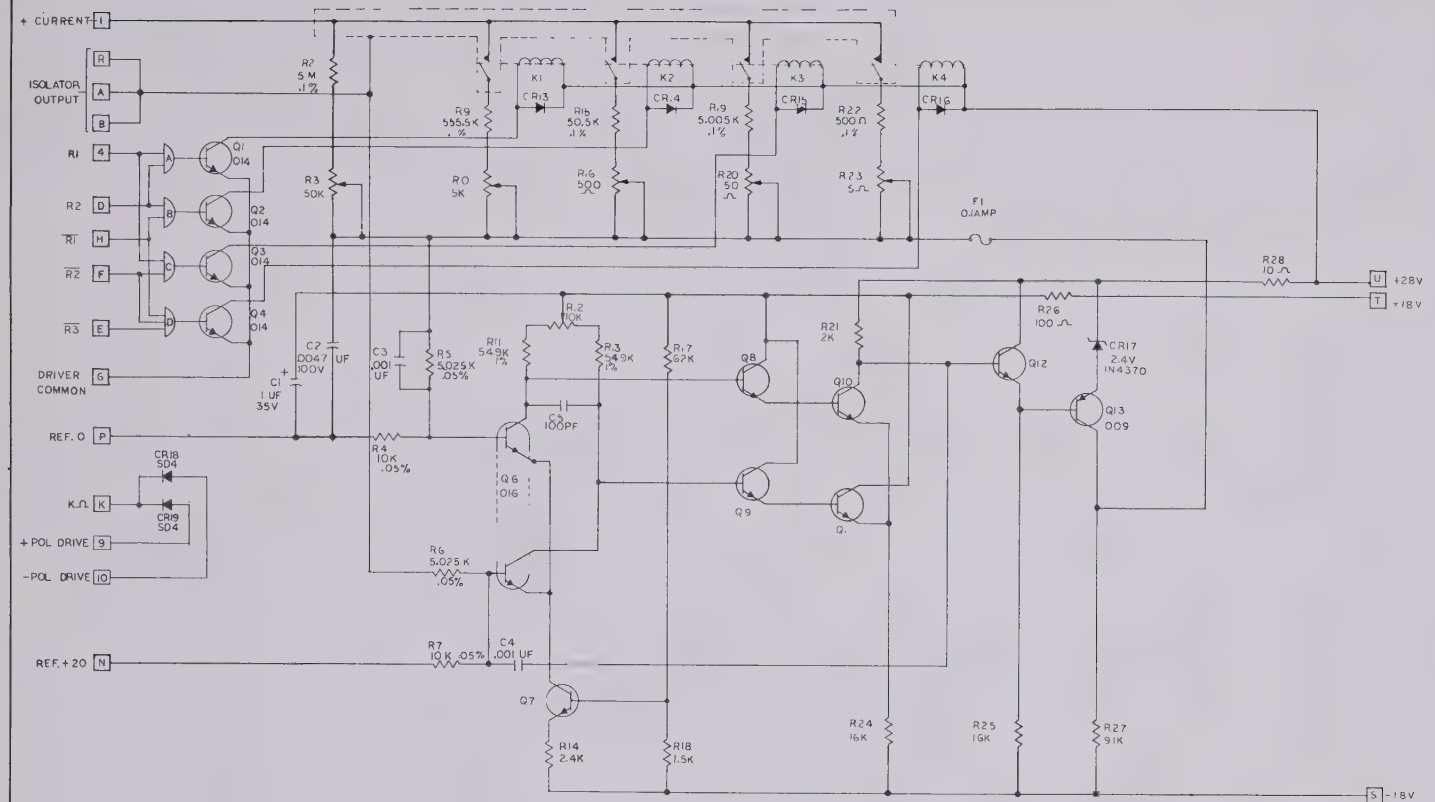
ALT 6-21-66
DRN 11 3.1.13

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y -
OHMS CONVERTER

SIZE	CODE IDENT NO.	DWG NO.	
D		400705	F

SCALE 2:1 WT SHEET 1 OF 1



6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics

5. Highest numbered reference designators:

R28	Q13
C 5	CR17

4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 018

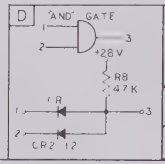
NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

D

"AND" GATE



MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS ANGLES
X ± .030 ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AX S SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

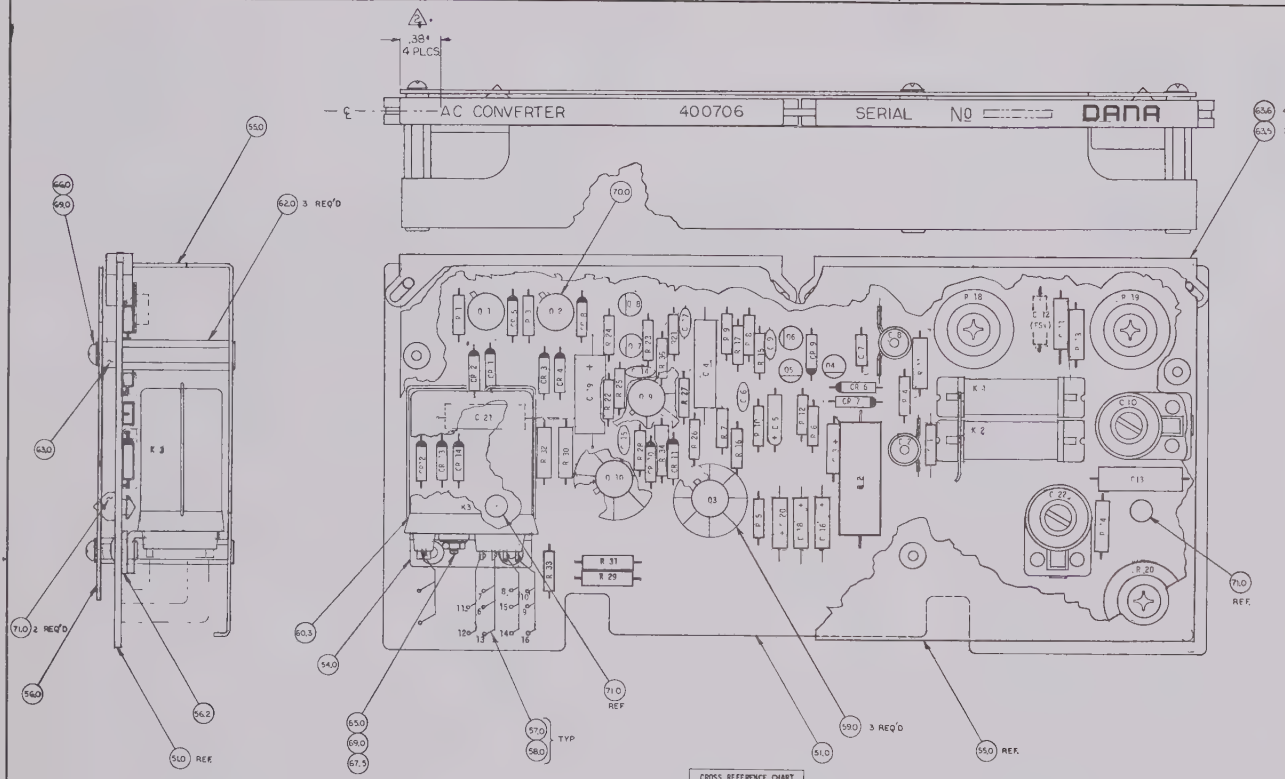
	NAME	DATE
DRA	CHAUSSEE	9-22-65
CHK	[illegible]	9-28-65
APPD	[illegible]	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - OHMS CONVERTER

SIZE	CODE IDENT NO.	DWG NO.
D	—	430303 D

SCALE — WT — SHEET 1 OF 1



REF DES	B/M ITEM	DESCRIPTION
R 30	25.0	270 K, .1%
R 29	25.0	270 K, .1%
R 28	11.0	39 ohm
R 27	18.0	91 ohm
R 26	2.0	10 K
R 25	13.0	4.3 K
R 24	10.0	33 ohm
R 23	17.0	750 ohm
R 22	10.0	33 ohm
R 21	5.0	15 K
R 20	27.0	50 ohm, CTS
R 19	28.0	500 ohm, CTS 10 TURN
R 18	28.0	5 K, CTS
R 17	12.0	3.9 K
R 16	6.0	200 ohm
R 15	4.0	1.5 K
R 14	23.6	3.319 K, .25% MATCH SET
R 13	23.5	36.53 K, .25% MATCH SET
R 12	19.0	91 K
R 11	23.6	329 K, .25% MATCH SET
R 10	6.0	200 ohm
R 9	9.0	2.7 K
R 8	15.0	6.8 K
R 7	14.0	47 ohm
R 6	19.0	91 K
R 5	1.0	100 ohm
R 4	16.0	680 K
R 3	14.3	47 K
R 2	23.5	1 M, .1% MATCH SET
R 1	14.3	47 K

REF DES	B/M ITEM	DESCRIPTION
C 22	42.0	7-45 pf
C 21	37.0	.39 MFD 100V
C 20	32.0	6.8 MFD 35V
C 19	33.0	22 MFD 35 V
C 18	37.0	6.8 MFD 35V
C 17	29.0	22 pf
C 16	32.0	6.8 MFD 35V
C 15	31.0	470 pf
C 14	30.0	10 pf
C 13	42.6	3000 pf
C 12		FSV (Normally not Used)
C 11	42.5	240 pf
C 10	42.0	7-45 pf
C 9	30.0	10 pf
C 8	40.0	1-5 pf
C 7	42.4	27 pf 5%
C 6	31.0	470 pf
C 5	32.0	6.8 MFD 35V
C 4	35.0	50 MFD 15V
C 3	34.0	1 MFD 35V
C 2	40.0	1-5 pf
C 1	41.0	6.8 pf, Glass
R 35	4.0	1.5 K
R 34	19.5	820 ohm 1/2 W
R 33	7.0	2 K
R 32	24.0	135 K, .1%
R 31	24.0	135 K, .1%

REF DES	B/M ITEM	DESCRIPTION
K 3	50.0	4 PDT
K 2	49.0	SPST
K 1	49.0	SPST
Q 10	44.0	014
Q 9	43.0	009
Q 8	45.0	2N3565
Q 7	45.0	2N3565
Q 6	45.0	2N3565
Q 5	45.0	2N3565
Q 4	45.0	2N3565
Q 3	44.0	014
Q 2	44.0	014
Q 1	44.0	014
CR14	46.0	SM 4
CR13	46.0	SM 4
CR12	46.0	SM 4
CR11	47.0	018
CR10	47.0	018
CR 9	48.0	1N961R
CR 8	47.0	018
CR 1	47.0	018

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
51.0	410159 F
54.0	450854
55.0	450960
56.0	450961
56.2	450963
57.0	500004
58.0	501376
59.0	600016
60.3	600272
62.0	610220
63.0	610221
63.5	610236
63.6	610237
65.0	615042
66.0	615044
67.5	617016
69.0	617077
70.0	920006
71.0	920033

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ±.030, .XX ±.020, .XXX ±.010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	10 NOV 65
CHK	[illegible]	11 NOV 65
APPD	[illegible]	11 NOV 65

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y-
AC CONVERTER

SIZE	CODE IDENT NO.	DWG NO.	
D	—	400706	J

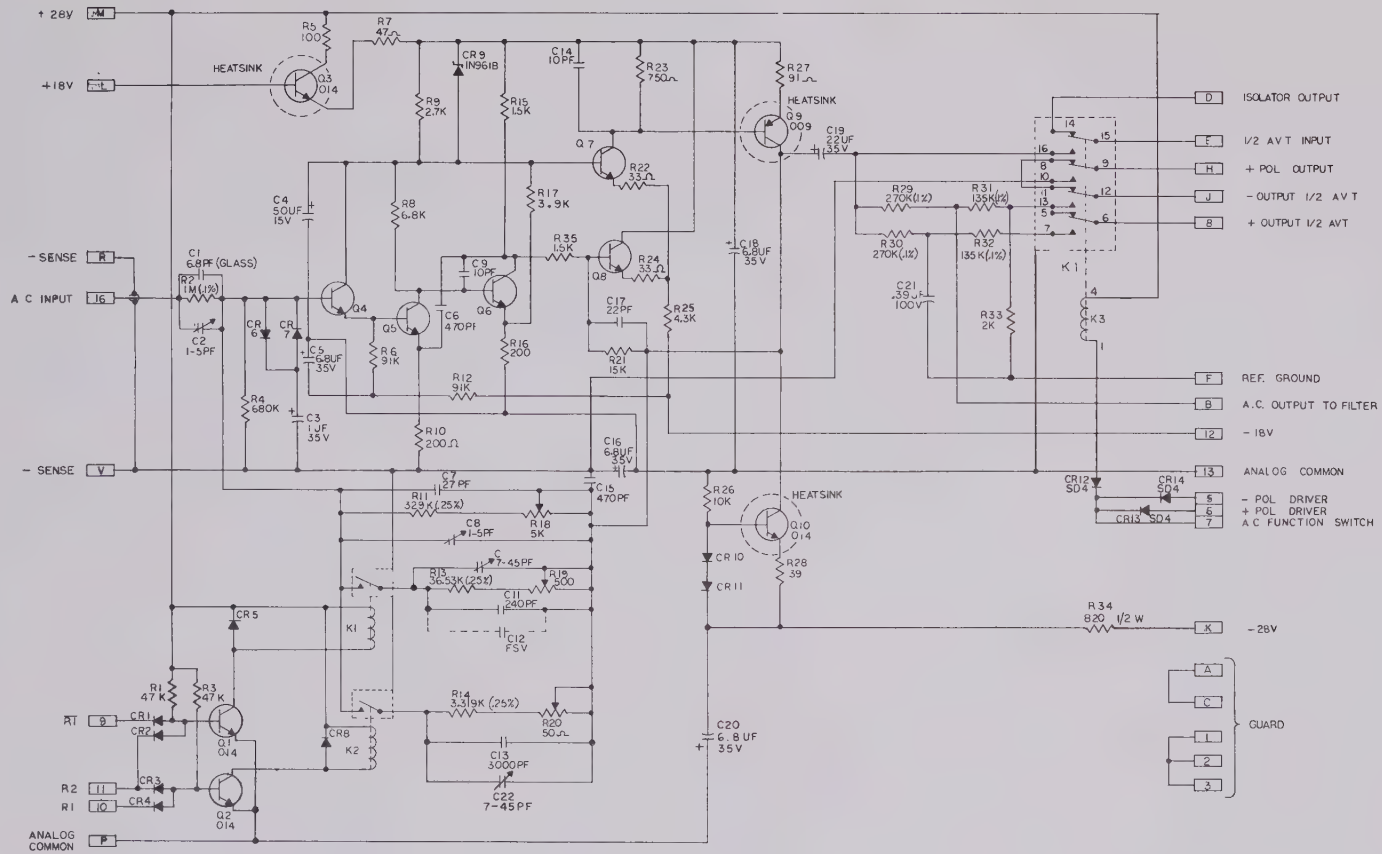
SCALE 2/1 | WT — | SHEET 1 OF 1

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO. LOCATED AS SHOWN.

1. ALL RESISTORS ARE 1/4 W ± 5% CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS / ANGLES
X ± .030 / ± 0° 30'
XX ± .020
.XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	9-22-65
CHK	[illegible]	9/27/65
APPD	[illegible]	9/24/65

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

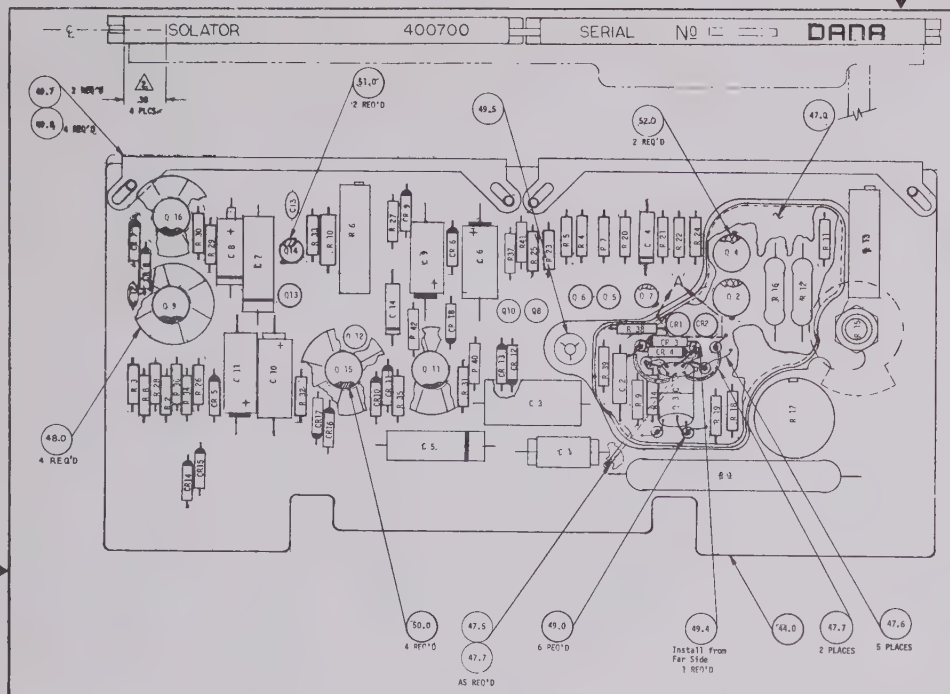
SCHEMATIC —
A.C. CONVERTER

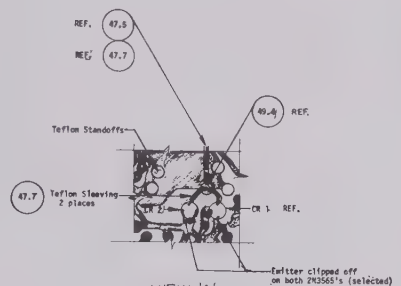
SIZE	CODE IDENT NO.	DWG NO.	
D	——	430306	B

SCALE —— WT —— SHEET 1 OF 1

5. Highest numbered reference designators:
   R34 Q10
   C21 CR14
4. All voltages referenced to analog common
3. All trimmisters 243565
2. All resistors 1/4W, 5%, carbon
1. All diodes 018

NOTES: UNLESS OTHERWISE SPECIFIED





VIEW 'A'
BOTTOM VIEW OF P.C. BOARD

CROSS REFERENCE CHART	
ITEM NO	PART NO
44.0	410162 M
47.0	450879
47.5	500004
47.6	500637
47.7	501376
48.0	600016
49.0	600030
49.4	600243
49.5	610087
49.7	610236
49.8	610237
50.0	920006
51.0	920007
52.0	920082

REF DES	B/M ITEM	DESCRIPTION
CR18	43.5	IN4370
CR17	42.3	004
CR16	42.3	004
CR15	42.0	018
↓	↓	↓
CR10	42.0	018
CR9	43.0	1N958B
CR8	42.0	018
CR7	42.0	018
CR6	43.0	1N958B
CR5	42.0	018
CR4	42.5	007
CR3	42.5	007
CR2	39.5	200048
CR1	39.5	200048
C14	31.0	.01UF 100V
C13	25.7	100PF DISC
C12	25.5	15PF DISC
C11	28.0	25UF 50V
C10	28.0	25UF 50V
C9	27.0	50UF 12/15V
C8	28.0	5UF 50V
C7	29.0	.1UF 100V
C6	27.0	50UF 12/15V
C5	29.0	.1UF 100V
C4	31.0	.001UF 100V
C3	30.0	2.0UF 100V
C2	32.0	.0047UF 100V
C1	29.1	.001UF 500V

REF DES	B/M ITEM	DESCRIPTION
R34	12.8	510 OHMS
R33	9.7	3.3K
R32	13.0	51K
R31	4.0	1.2K
R30	17.0	75 OHMS
R29	9.3	24 OHMS
R28	20.0	9.1K
R27	20.0	9.1K
R26	8.0	15K
R25	11.0	43K
R24	2.0	1K
R23	10.0	3.3 MEG
R22	10.5	39K
R21	20.0	9.1K
R20	2.0	1K
R19	17.0	75 OHMS
R18	18.0	7.5K
R17	23.0	5K POT
R16	21.0	4.99 MEG,1%
R15	24.0	250K POT
R14	10.0	3.3 MEG
R13	25.0	500K POT
R12	21.0	4.99 MEG,1%
R11	5.0	120K
R10	22.2	49.9Ω, 1%
R9	9.5	2.4K
R8	1.0	100 OHMS
R7	7.0	1.5K
R6	22.6	5K POT
R5	18.0	8.2K
R4	7.0	1.5K
R3	1.0	100 OHMS
R2	18.1	82K
R1	22.0	25 MEG,1%

REF DES	B/M ITEM	DESCRIPTION
Q16	35.0	Q14
Q15	35.0	Q14
Q14	33.8	Q12
Q13	39.0	2N3565
Q12	39.0	2N3565
Q11	39.8	009 FAIRCHILD
Q10	39.0	2N3565
Q9	35.0	Q14
Q8	39.0	2N3565
Q7	33.8	Q12
Q6	39.1	200044 MATCHED PAIR
Q5	39.1	200044 MATCHED PAIR
Q4	39.8	200083 SELECTED Q18
Q3	40.0	2N1304
Q2	39.8	200083 SELECTED Q18
Q1	36.0	Q15
R42	1.0	100 OHMS
R41	11.5	4.7K
R40	8.0	15K
R39	5.3	1.3K
R38	5.5	13 MEG
R37	15.0	5.8 MEG
R36	9.3	24 OHMS
R35	1.0	100 OHMS

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ±.030, XX ±.020, XXX ±.010; ANGLES ±0° 30'
FORMED ANGLES ±1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR		11-30-65
CHK		11-30-65
APPD		11/7/65

ML 6-22-66
DRW 438 BD

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y - ISOLATOR

SIZE D | CODE IDENT NO. | DWG NO. 400700 | N

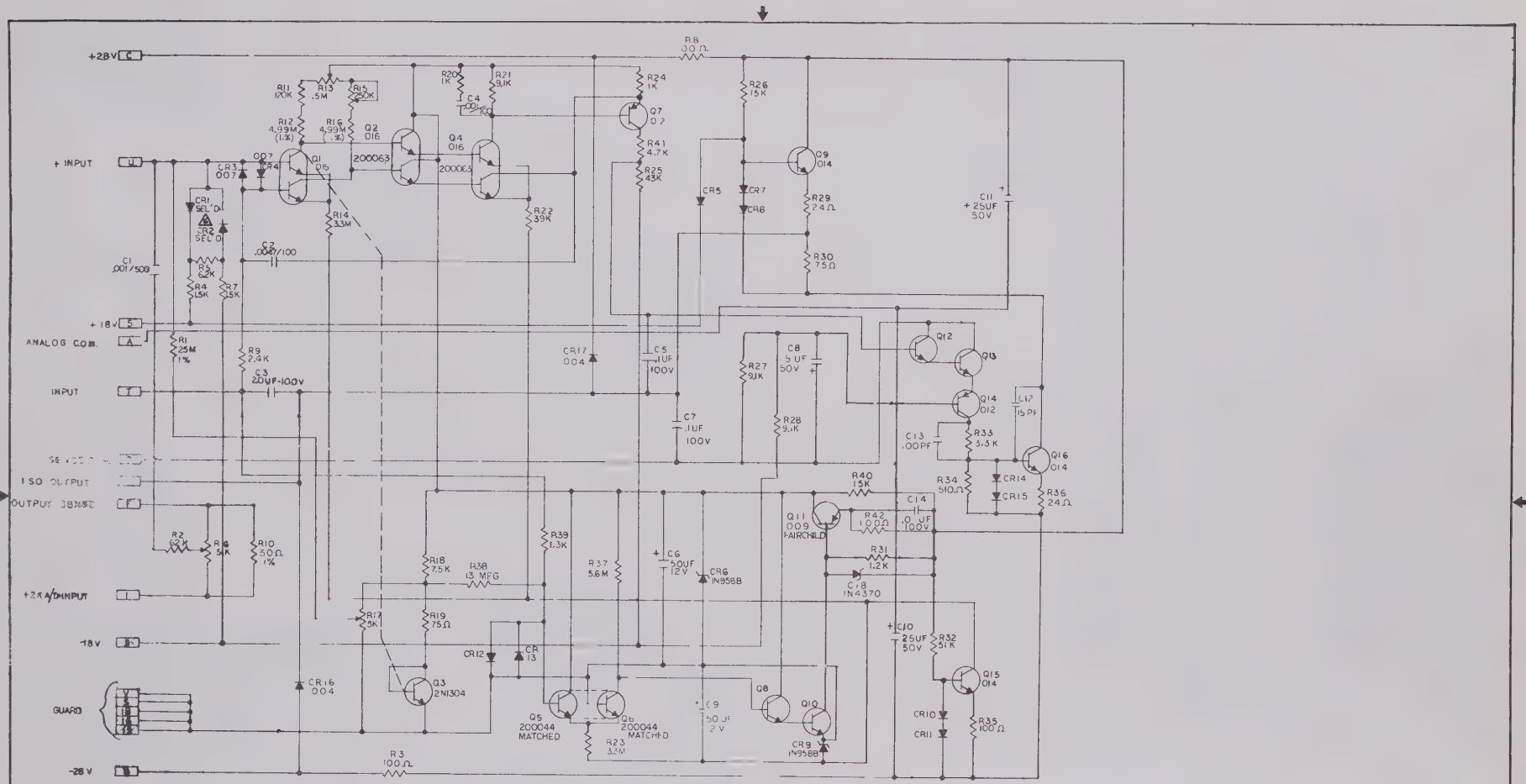
SCALE 2:1 | WT | SHEET 1 OF 1

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

Heat stamp .10 high block characters and .16 high logo, location as shown.

2. All resistors 1/4 W, 5% carbon

NOTES: UNLESS OTHERWISE SPECIFIED



⚠ CR 1 & CR 2 are same P/N assembly selected for matched pair.

5. Highest numbered reference designators:

R42	Q16
C14	CR18

4. All voltages referenced to analog common
3. All transistors 2N3565
2. All resistors 1/4W, 5%, carbon
1. All diodes 018

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± 010; ANGLES ± 0° 30'
FORMED ANGLES ± 1 0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D-1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	9-4-65
CHK	[illegible]	10-4-65
APPD	[illegible]	16-6-65

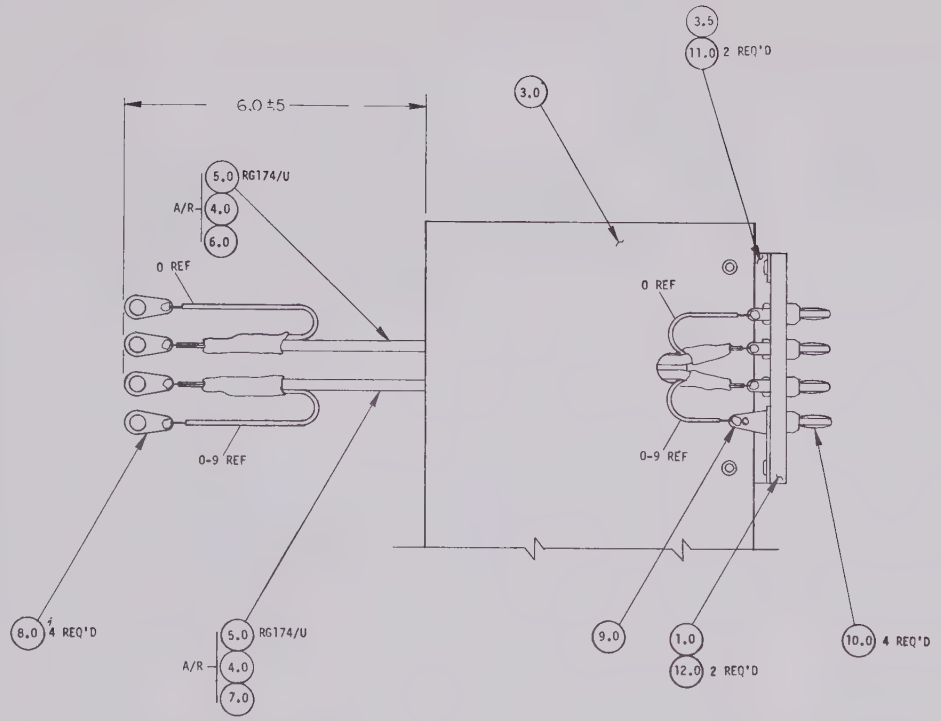
Rel 6.22.66
DRN 4388B

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — ISOLATOR

SIZE	CODE IDENT NO.	DWG NO.	
D	—	430305	K

SCALE — | WT — | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
1.0	450979
3.0	450982
3.5	452168
4.0	500002
5.0	501446
6.0	524000
7.0	524090
8.0	600028
9.0	600032
10.0	600232
11.0	610077
12.0	610138

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

FCCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR	28 APR 1966
CHK	4 APR 1966
APPD	

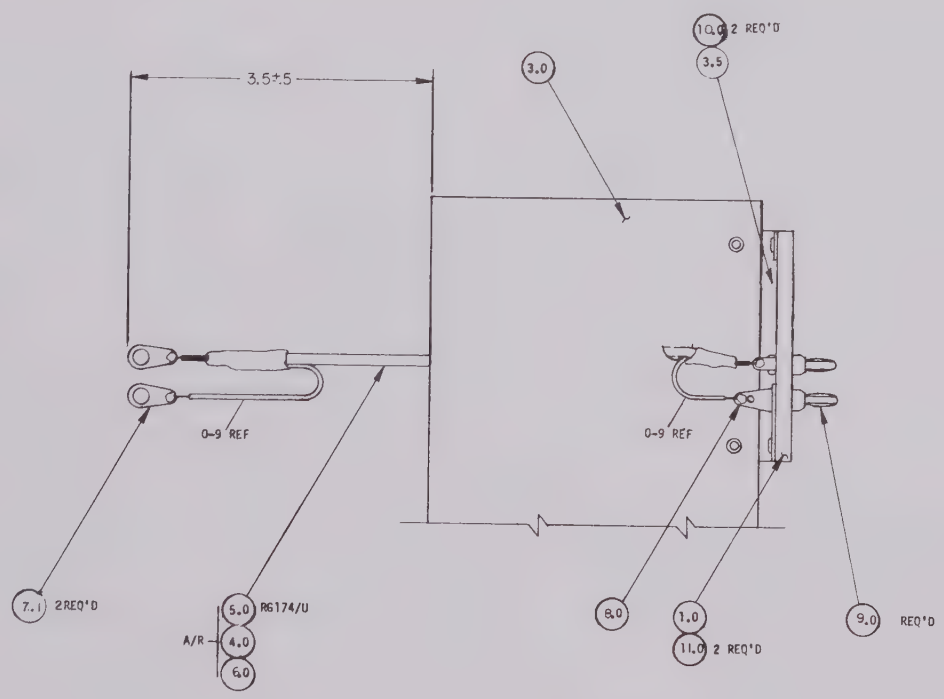
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

REAR INPUT PLUG ASSY-4 WIRE

SIZE	CODE IDENT NO.	DWG NO.	
C	———	402009	C

SCALE FULL | WT ——— | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON DECIMALS: X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR [illegible]	APR 1966
CHK	
APPD	

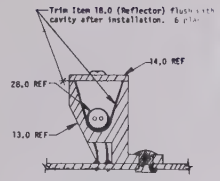
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

REAR INPUT PLUG ASSY WIRE

SIZE	CODE IDENT NO.	DWG NO.
C	———	402010 B

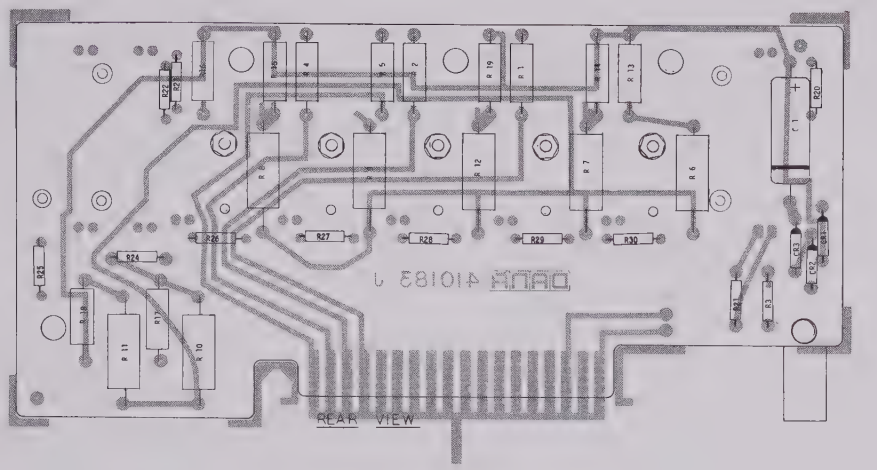
SCALE FULL | WT ——— | SHEET 1 OF 1

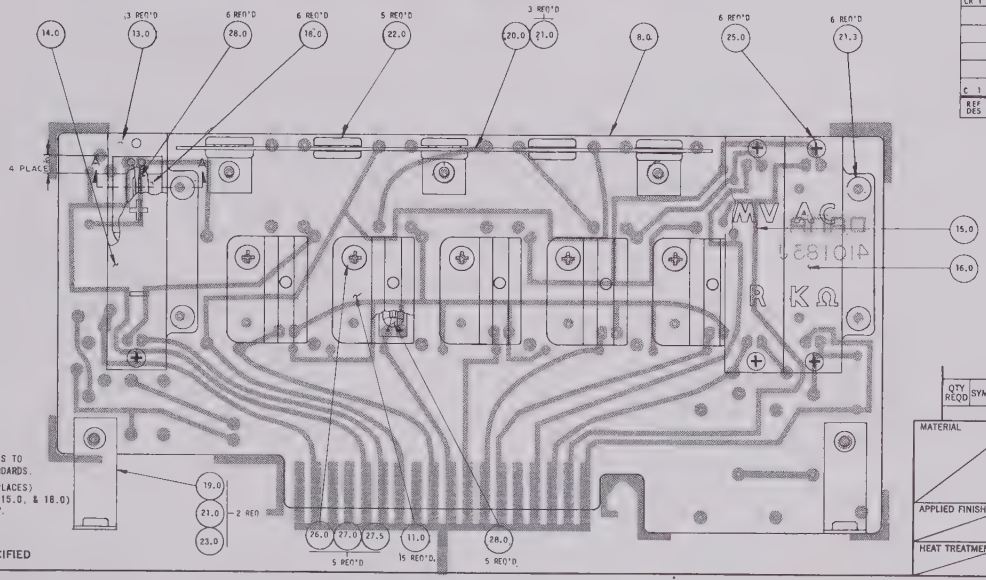
NOTES: UNLESS OTHERWISE SPECIFIED



SECTION A-A
TYPICAL 3 PLACES

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
8.0	410183-1
11.0	450784
13.0	450788
14.0	450873
15.0	450874
16.0	450875
18.0	450876
19.0	450880
20.0	450882
21.0	610019
21.3	610022
22.0	610027
23.0	610111
25.0	610209
26.0	615542
27.0	617016
27.5	617077
28.0	920116





REF DES	B/M ITEM	DESCRIPTION
R 19 thru R 13	5.0	130K 1 W
R 12 thru R 6	4.0	100 K 2 W
R 5	3.0	20 K 1 W
R 4	2.0	39 K 1 W
R 3	1.0	220 K 1/4W
R 2	3.0	20 K 1 W
R 1	2.0	39 K 1 W
CR 3 thru CR 1	7.0	SD 4
C 1	6.0	250 MFD 6V

REF DES	B/M ITEM	DESCRIPTION
R30 thru R20	1.5	910 K

4. SCHEMATIC REFERENCE: 430301
3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
2. INDICATOR TUBE ON ITEM 11.0 (5 PLACES) AND DISPLAY SCREENS (ITEM 14.0, 15.0, & 18.0) TO BE MASKED BEFORE " HUMI SEAL".
1. ALL NEON LAMPS ARE NE-211

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	11-9-65
CHK	[illegible]	17 NOV 65
APPD	[illegible]	

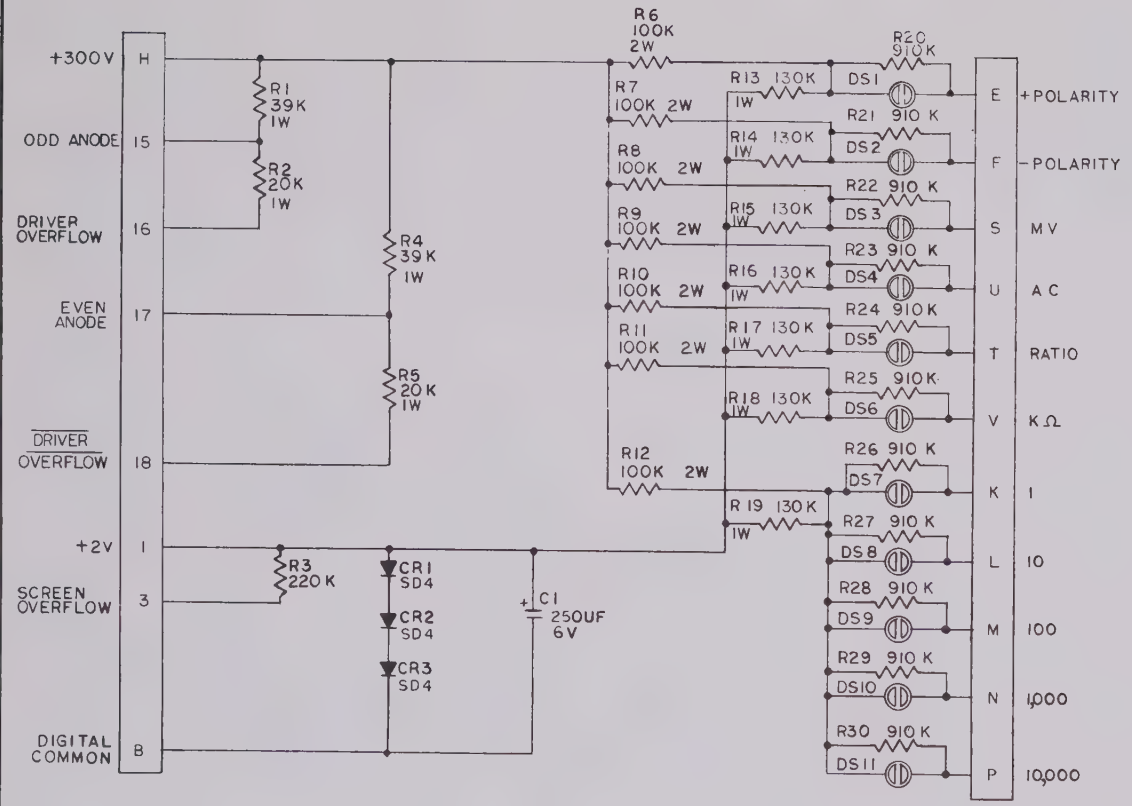
E.O. 11-19-65
DRN # 207

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASS'Y - DISPLAY

SIZE	CODE IDENT NO.	DWG NO.	
D		400691	K

SCALE 2 : 1 | WT | SHEET 1 OF 1



3 HIGHEST REFERENCE DESIGNATORS ARE:
R30
DS11
CR4
C1

2. ALL NEON LAMPS ARE NE-2H
1. ALL RESISTORS 1/4W, 5%, CARBON
NOTES: UNLESS OTHERWISE SPECIFIED

400691	754 COUPLER	REF	REF
400691	HARDY SCALES	REF	REF
400691	5503 SER DVM	REF	REF
400691	5400 SER DVM	REF	REF
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
MATERIAL
APPLIED FINISH

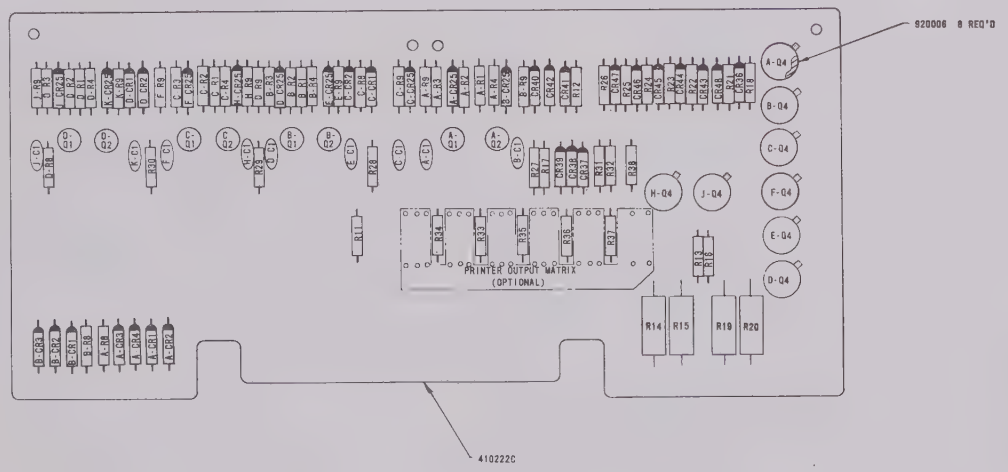
DRAWN 10-18-65
CHECK 19 OCT 65
ENGR 21 OCT 65
APPR
APPROVED
APPROVED 11-19-65

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC —
DISPLAY

CODE IDENT NO. | SIZE C | 430301 | F
SCALE | WEIGHT | SHEET 1 OF 1

F | 430301



REF DES	PART NO	DESCRIPTION
R18	000103	10 K
R15	001107	39 K, 1 W
R14	001898	20 K, 1 W
R13	000103	10 K
R12	000103	10 K
R11	000204	200 K
R9	000273	27 K
R8	000243	24 K
R4	000153	15 K
R3	000122	1.2 K
R2	000153	15 K
R1	000122	1.2 K
Q4	200035	014
Q2	200037	2N3648
Q1	200037	2N3648
CR48	211083	018
↓	↓	↓
THRU		
↓	↓	↓
CR36	211083	018
CR25	211083	018
CR4	↓	↓
CR3		
CR2	↓	↓
CR1	211083	018
C1	100012	33 PF DISC

REF DES	PART NO.	DESCRIPTION
R38	000204	200 K
R37	000473	47 K
↓	↓	↓
THRU	↓	↓
R33	000473	47 K
R32	000583	58 K
R31	000683	68 K
R30	000223	22 K
↓	↓	↓
THRU	↓	↓
R27	000223	22 K
R26	000103	10 K
↓	↓	↓
THRU	↓	↓
R21	000103	10 K
R20	001898	20 K, 1 W
R19	001107	39 K, 1 W
R15	000103	10 K
R17	000103	10 K

NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	
402269	5500 BASIC	1	3
	5A00, 5403 BASIC	1	4
402357	MOD G1, P2	1	4
	73-E2, 75-E2	1	5
	G2-E2, G5-E2	1	4
402342	MOD G1-P1	1	4
	73-E1, 75-E1	1	5
	G3-E1, G5-E1	1	4
402343	MOD G1, M2	1	4
	73-D2, 75-D2	1	3
	G3-D2, G5-D2	1	4
402162	MOD G, M1	1	4
	73-01, 74, 75-01	1	5
	G3-01, G4, G5-01	1	4

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030 XX .005 XXX .015 | ANGLES 0° 30' | FORMED ANGLES ±0
MATERIAL
FINISH

CONTRACT NO.

DRAWN ABBOTT 11/1/67
CHECK 11/14/67
COG ENGR 11/16/67
PROJ ENGR 11/16/67
SEN 11-67

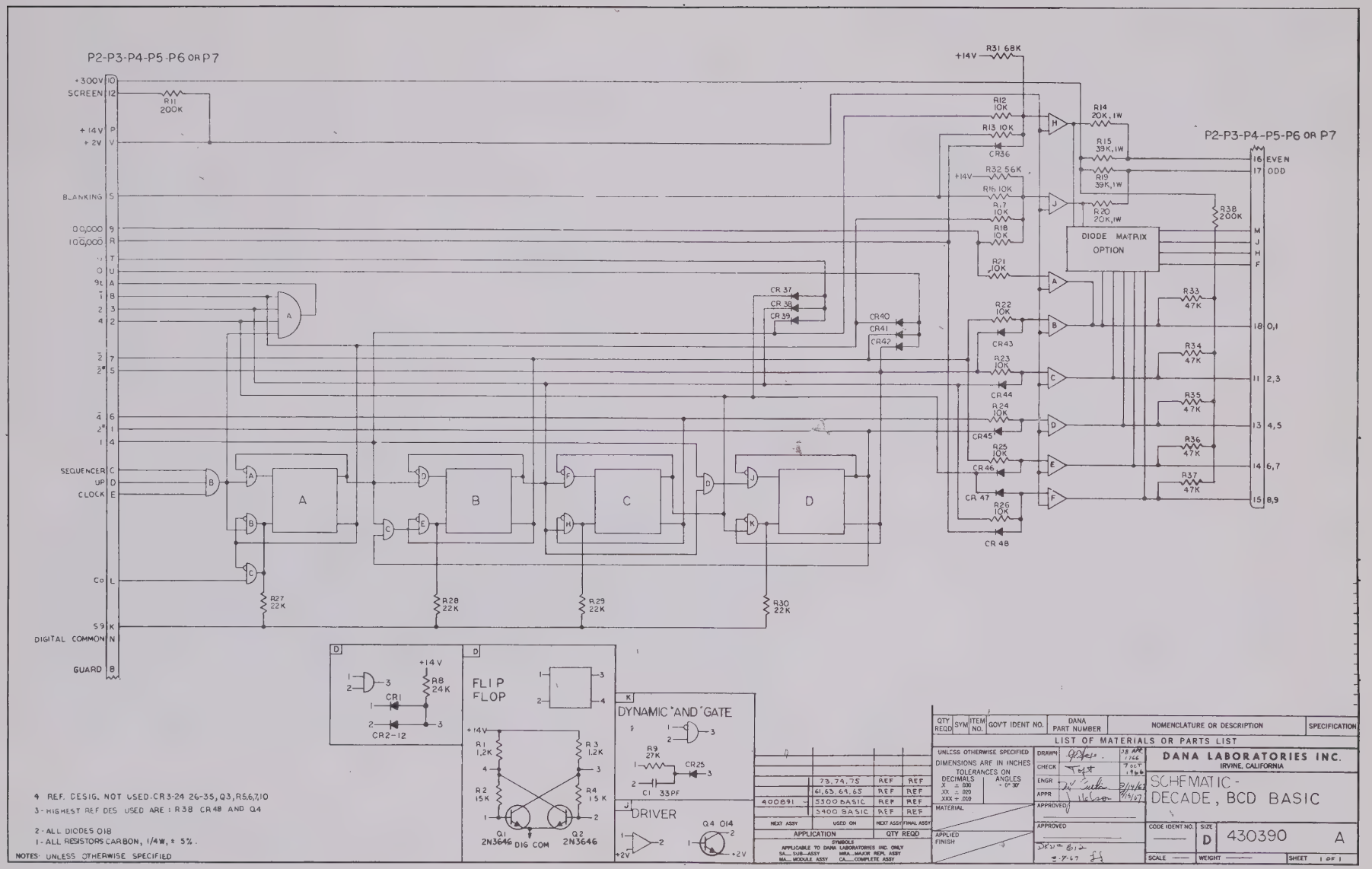
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY —
DECADE, BASIC

SIZE D | CODE IDENT NO. — | DWG NO. 400891 | REV A
SCALE 2/1 | WT — | SHEET 1 OF 1

3. SCHEMATIC REFERENCE: 430390
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED



4 REF. DESIG. NOT USED: CR3-24 26-35, Q3, R5,6,7,10

3 - HIGHEST REF DES USED ARE : R38 CR48 AND Q4

2 - ALL DIODES 018

1 - ALL RESISTORS CARBON, 1/4W, ± 5%.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
73,74,75					REF	REF
61,63,64,65					REF	REF
400891				5300 BASIC	REF	REF
				5400 BASIC	REF	REF

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY | USED ON | NEXT ASSY | FINAL ASSY

APPLICATION | QTY REQD

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN 28 APR 1966
CHECK 7 OCT 1966
ENGR 9/14/67
APPR 9/5/67
APPROVED
APPROVED

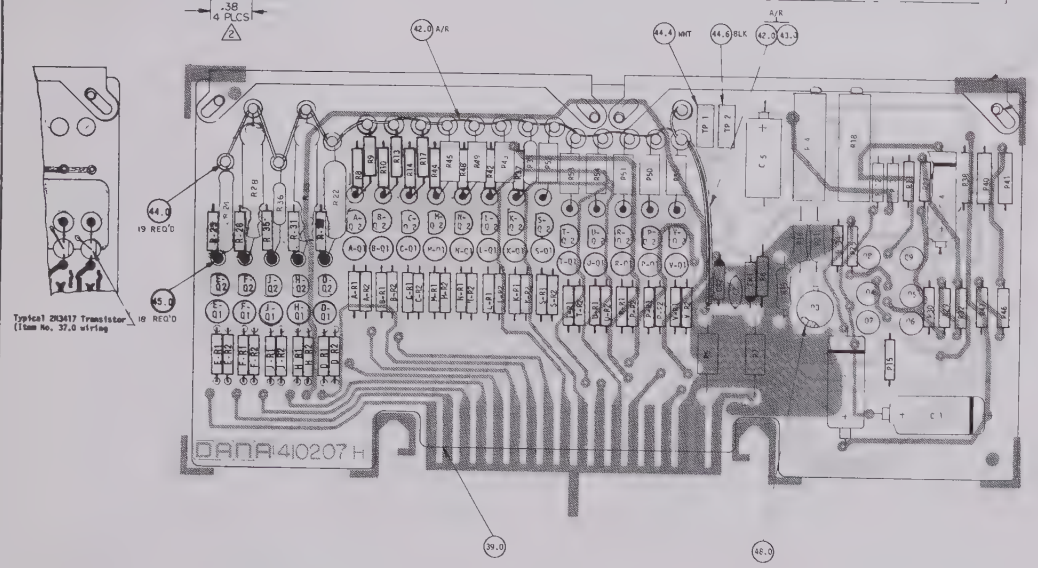
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC - DECADE, BCD BASIC

CODE IDENT NO. | SIZE D | 430390 | A

SCALE | WEIGHT | SHEET 1 OF 1

NULL DETECTOR 400843 SERIAL NO ---- DANA



CROSS REFERENCE CHART	
ITEM NO	PART NO
39.0	410207 H
42.0	300004
43.0	501376
44.0	600030
44.4	600142
44.6	600144
45.0	600243
45.5	610236
45.6	610237
48.0	920082

REF DES	B/M ITEM	DESCRIPTION
R 24	21.0	5 Meg 1%
R 23	1.0	100K
R 22	20.0	12.5 Meg 1%
R 21	17.0	15 K RN60D
R 20	1.0	100 K
R 19	23.0	154 k 1%
R 18	30.0	POT 2 K E-Z TRIM
R 17	7.0	24 Meg
R 16	17.0	15 k RN60
R 15	6.0	330 OHMS
R 14	1.0	100K
R 13	7.0	24 Meg
R 12	11.0	4.3 k
R 11	5.0	13 k
R 10	1.0	100 K
R 9	13.0	51 Meg
R 8	1.0	100 K
R 7	25.0	2400.090HM .01%
R 6	14.0	680 K
R 5	24.0	4948.22 OHM .01%
P 4	31.0	POT 5 K E-Z TRIM
P 3	5.5	200k
R 2	9.0	33 k
R 1	12.0	47 k
CR 2	38.0	018
CR 1	38.0	018
C 5	32.5	22 uF/35V
C 4	33.5	1 mfd 50 v
C 3	33.0	25 mfd 50 v
C 2	32.0	220 pf DISC
C 1	33.0	25 mfd 50 v

REF DES	B/M ITEM	DESCRIPTION
V-02	37.2	HIGH ORDER DAC (WHT)
THRU		
P-02	37.2	HIGH ORDER DAC (WHT)
N-02	37.3	LOW ORDER DAC (YEL)
THRU		
A-02	37.3	LOW ORDER DAC (YEL)
Q 1	37.0	2N3644
R 55	26.0	49.995 K .01%
R 54	27.0	24.995 K .01%
R 53	27.0	24.995 K .01%
R 52	26.0	49.995 K .01%
R 49	28.0	125 K .05%
R 48	1.0	100 K
R 47	4.0	120 K
R 46	7.5	27 K
R 45	29.0	250 K .05%
R 44	1.0	100 K
R 43	29.0	250 K .05%
R 42	1.0	100 K
R 41	15.0	4.7 K 1/2 W
R 40	16.0	8.2 K 1/2 W
R 39	18.0	500 K .1%
R 38	15.0	4.7 K 1/2 W
P 37	1.0	100 K
R 36	23.3	1.25 Meg .1%
R 35	1.0	100 K
R 34	10.0	330 K
R 33	23.4	2.5 Meg .25%
R 32	3.0	12 K
R 31	1.0	100 K
R 30	2.0	11 K
R 29	6.0	2.4 K
R 28	22.0	2.5 Meg .25%
R 27	3.0	12 K
R 26	1.0	100 K
R 25	10.0	330 K

REF DES	B/M ITEM	DESCRIPTION
Q 9 thru Q 4	36.0	2N3565
Q 3	36.0	015

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

4 SCHEMATIC REFERENCE: 430351

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

⚠ Heat Stamp .10 high black characters And .15 high Logo, Located as shown

1. All Resistors 1/4 W, 5%, Carbon

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS | ANGLES
X ± .030 | ± 0° 30'
XX ± .020
XXX ± .010
FORMED ANGLES ± 1 0°
ECCENTRICITY BETWEEN DIA ON THE SAME AX S SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE W TH STANDAROS M L D 1000 AND MIL-D-7032

CONTRACT NO.

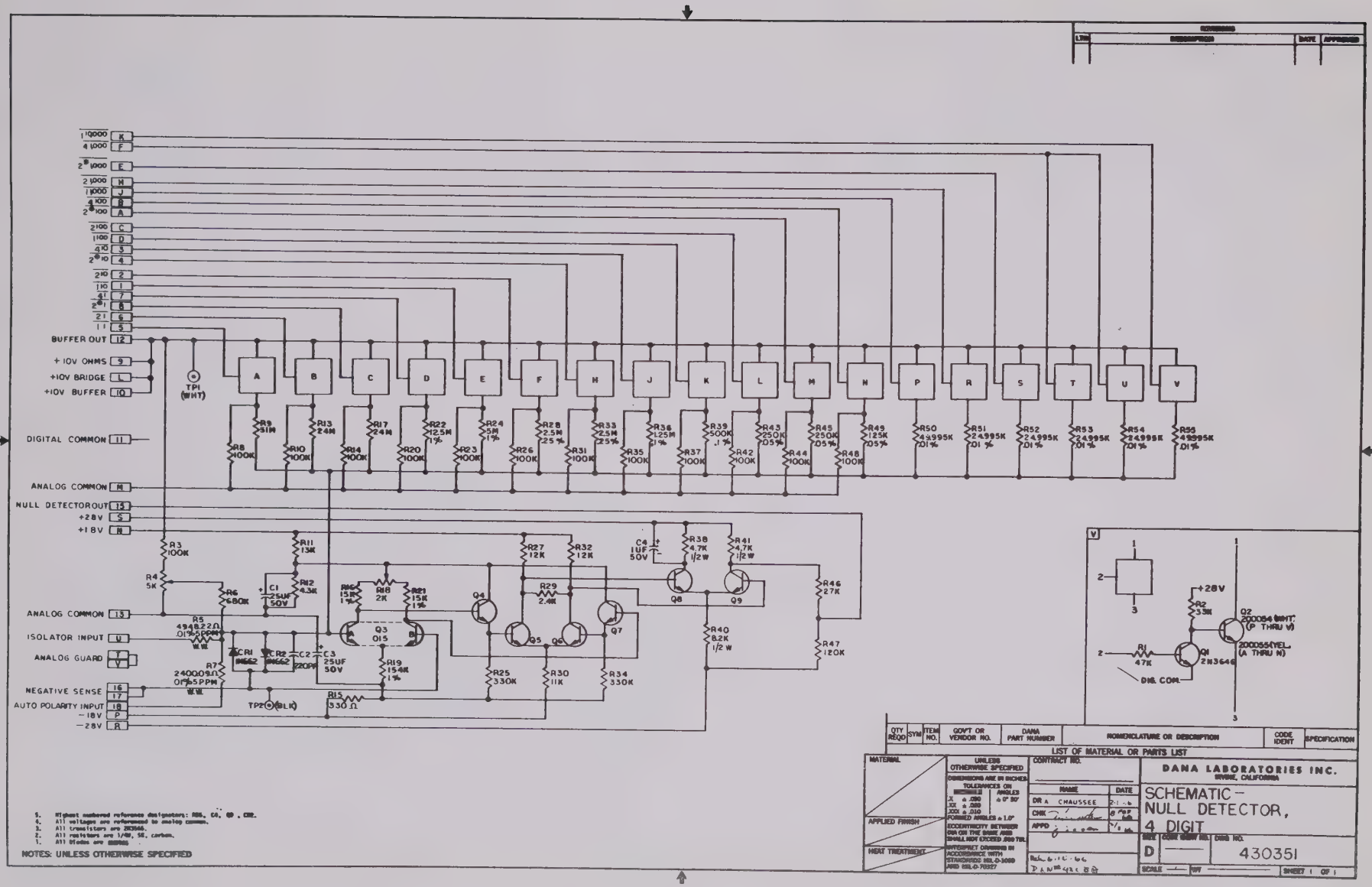
	NAME	DATE
DR	[illegible]	10 Feb 1966
CHK	Tuft	10 Feb 1966
APPD	[illegible]	

DRN BY CAD B

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY -
NULL DETECTOR, 4 DIGIT

SIZE	CODE IDENT NO.	DWG NO.	
D		400843	H
SCALE 2/1	WT	SHEET 1 OF 1	



NOTES: UNLESS OTHERWISE SPECIFIED

1. All voltages are referenced to analog common.
2. All resistors are 1/4W, 5%, carbon.
3. All transistors are 2N3646.
4. All diodes are 1N662.
5. Highest numbered reference designators: R55, C4, Q9, CR2.

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL | APPLIED FINISH | HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± 1/64
.X ± .030
.XX ± .005
.XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA OR THE SHAFT AND SHALL NOT EXCEED .003 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

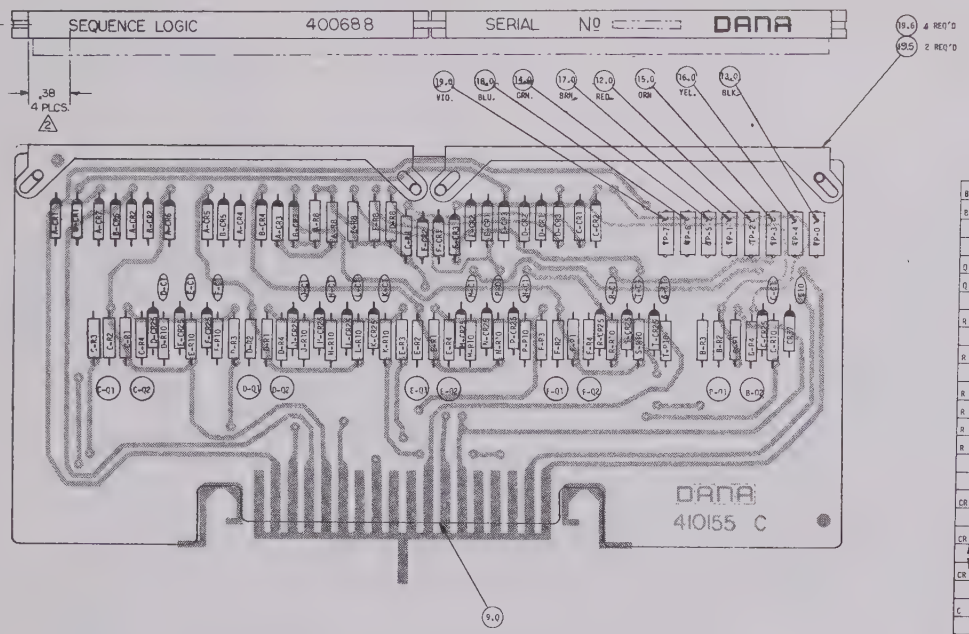
	NAME	DATE
DR	A CHAUSSEE	2-1-66
CHK		2-8-66
APPD		2-11-66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — NULL DETECTOR, 4 DIGIT

SIZE D | CODE IDENT NO. | DWG NO. 430351

SCALE — | WT — | SHEET 1 OF 1



REF DES	R/M ITEM	DESCRIPTION
R-R3	4.0	8.2 K
R-R1	6.0	8.2 K
Q 2	8.0	2N3646
Q 1	8.0	2N3646
R 10	5.0	27 K
R 8	0.7	12 K
R 4	1.0	15 K
R 3	3.0	2.2 K
R 2	1.0	15 K
R 1	3.0	2.2K
CR 25	8.5	1N662
CR 7	8.5	1N662
CR 1	8.5	1N662
C 10	7.5	280 PF
C 1	7.0	33 PF

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
9.0	410155 C
12.0	600143
13.0	600144
14.0	600145
15.0	600146
16.0	600147
17.0	600148
18.0	600149
19.0	600150
19.5	610236
19.6	610237

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

4. Black stamp .70 high block characters and .75 high tape, located as shown.

1. 680 resistors 1/4W, 5% carbon

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR	11-6-65
CHK	11-17-65
APPD	

E.R. 11-17-65
DEV # 201

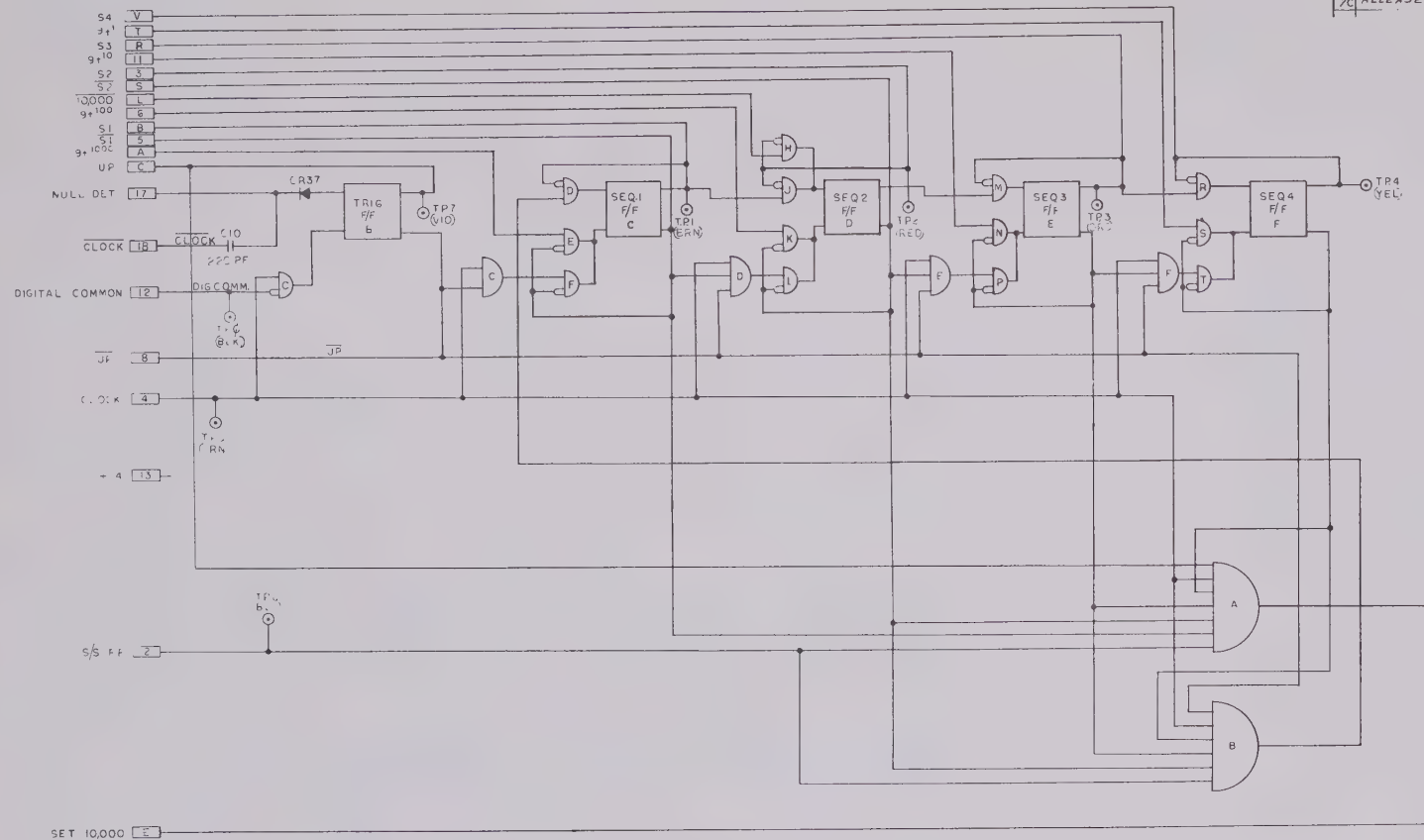
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

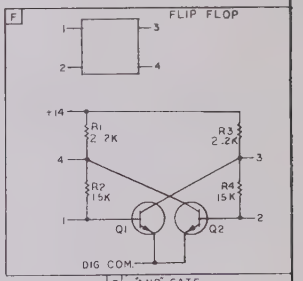
PC BOARD ASS'Y
SEQUENCE LOGIC

SIZE	CODE IDENT NO.	DWG NO.	
D		400688	E

SCALE 2:1 | WT | SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
N/C	RELEASED TO PRODUCTION PILOT		





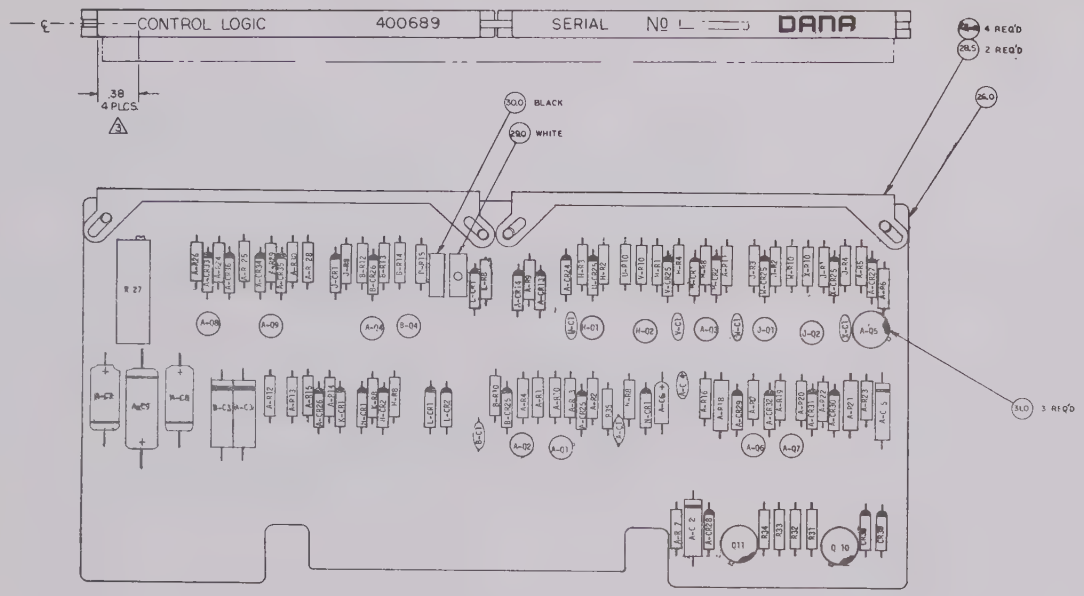
NOTES: UNLESS OTHERWISE SPECIFIED

1. Resistors are ... Part ...
2. All resistors 1/4W, 5%, Carbon
3. All transistors TIP 2N3640
4. All voltages referenced to digital common
5. Highest numbered reference designator for basic circuit is shown in ... left hand corner of the schematic
6. Highest numbered reference designator ... 9 10 11 12

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH	DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0°	NAME / DATE: DR, CHK, APPD	SCHEMATIC – SEQUENCE LOGIC, MODEL 5400 DVM
HEAT TREATMENT	ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327		SIZE D; CODE IDENT NO. —; DWG NO. 430348; SCALE —; WT —; SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
26.0	410154 F
28.5	610236
28.6	610237
29.0	620142
30.0	620124
31.0	620089

R 1	6.8	7.5K	
Q 11	23.0	014	
Q 10	23.0	014	
Q 9	24.0	2N3646	
Thru			
Q 6	24.0	2N3646	
Q 5	22.0	009	
Q 4	24.0	2N3646	
Thru			
Q 1	24.0	2N3646	
CR36	25.0	018	
Thru			
CR 1	25.0	018	
C 9	19.0	25 MFD 25 V	
C 8	18.0	5.0 MFD 50 V	
C 7	18.0	5.0 MFD 50 V	
C 6	17.0	1 MFD 35 V	
C 5	19.5	.0033 MFD 100 V	
C 4	16.5	.001 MFD DISC	
C 3	21.3	.015 MFD 100V	
C 2	21.5	.0015 MFD 100 V	
C 1	16.8	33 PF	

REF DES	B/M ITEM	DESCRIPTION
R 35	13.0	8.2 K
R 34	1.0	10 K
Thru		
R 31	1.0	10 K
R 30	11.0	27K
R 29	2.0	100 K
R 28	8.0	2.2 K
R 27	14.5	20 K (POT)
R 26	8.1	22K
R 25	8.0	3.2 K
R 24	2.0	100 K
R 23	5.0	15K
R 22	2.0	100 K
R 21	10.0	1.2 K 1/2W 5%
R 20	7.0	20 K
R 19	7.0	20 K
R 18	10.0	1.2 K 1/2W 5%
R 17	2.0	100 K
R 16	5.0	15 K
R 15	2.0	100 K
R 14	13.0	8.2 K
R 13	5.0	15 K
R 12	10.0	24 K
R 11	6.0	280 ohms
R 10	11.0	27 K
R 9	7.5	200 K
R 8	13.0	3W K
R 7	9.0	2.4 K
R 6	5.0	15 K
R 5	12.0	6.2 K
R 4	5.0	15 K
R 3	8.0	2.2K
R 2	5.0	15 K

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR W.Eoff	11-17-65
CHK W.McCurdy	11-17-65
APPD Joe Bruce	11-17-65

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY-
CONTROL LOGIC

SIZE	CODE IDENT NO.	DWG NO.	
D	—	400689	J

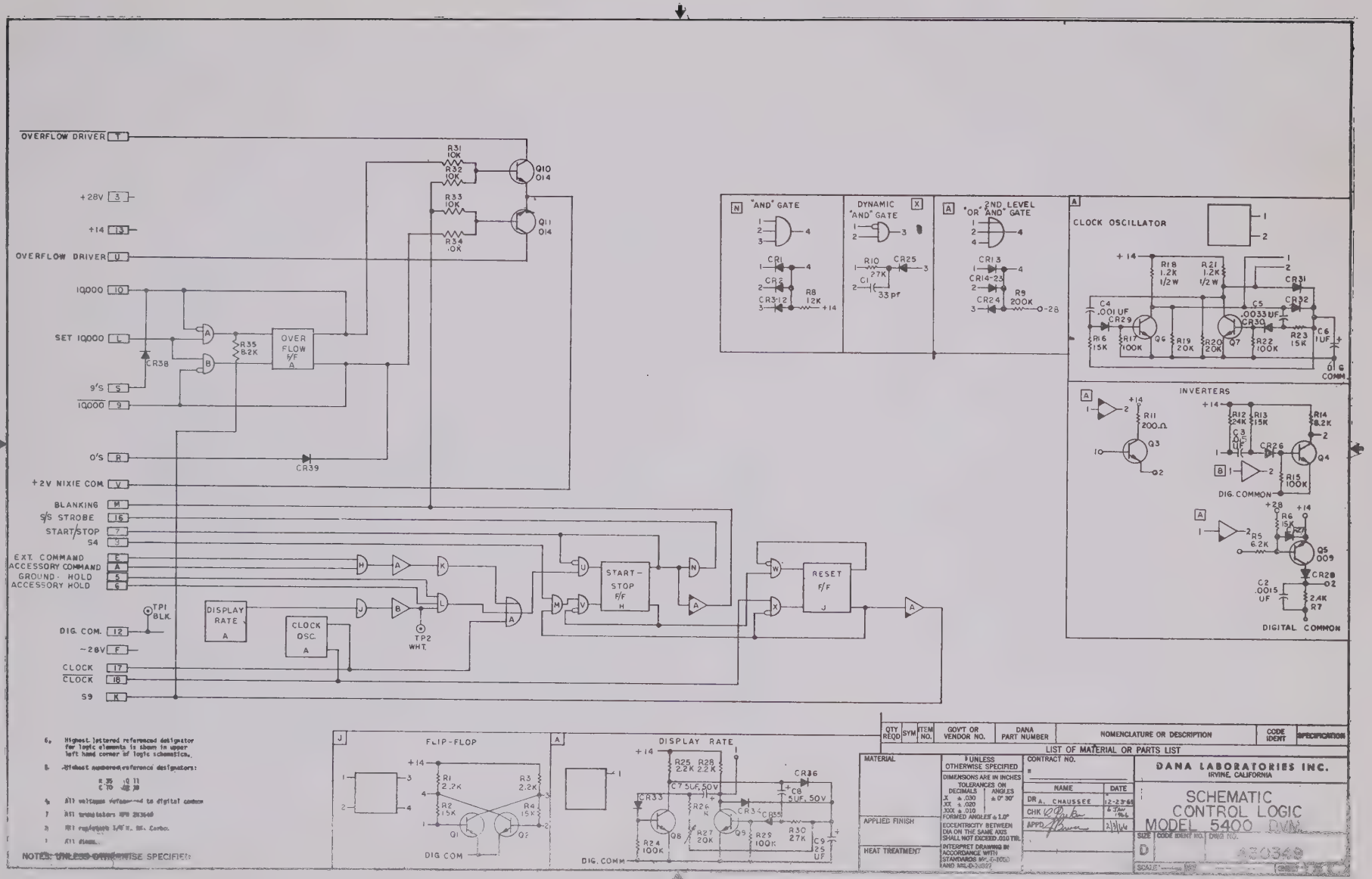
SCALE 2/1 | WT — | SHEET 1 OF 1

⚠ HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.

2. ASSEMBLY PROCEDURES AND PROCESSES TO COMPLY WITH DANA WORKMANSHIP STANDARDS.

1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED



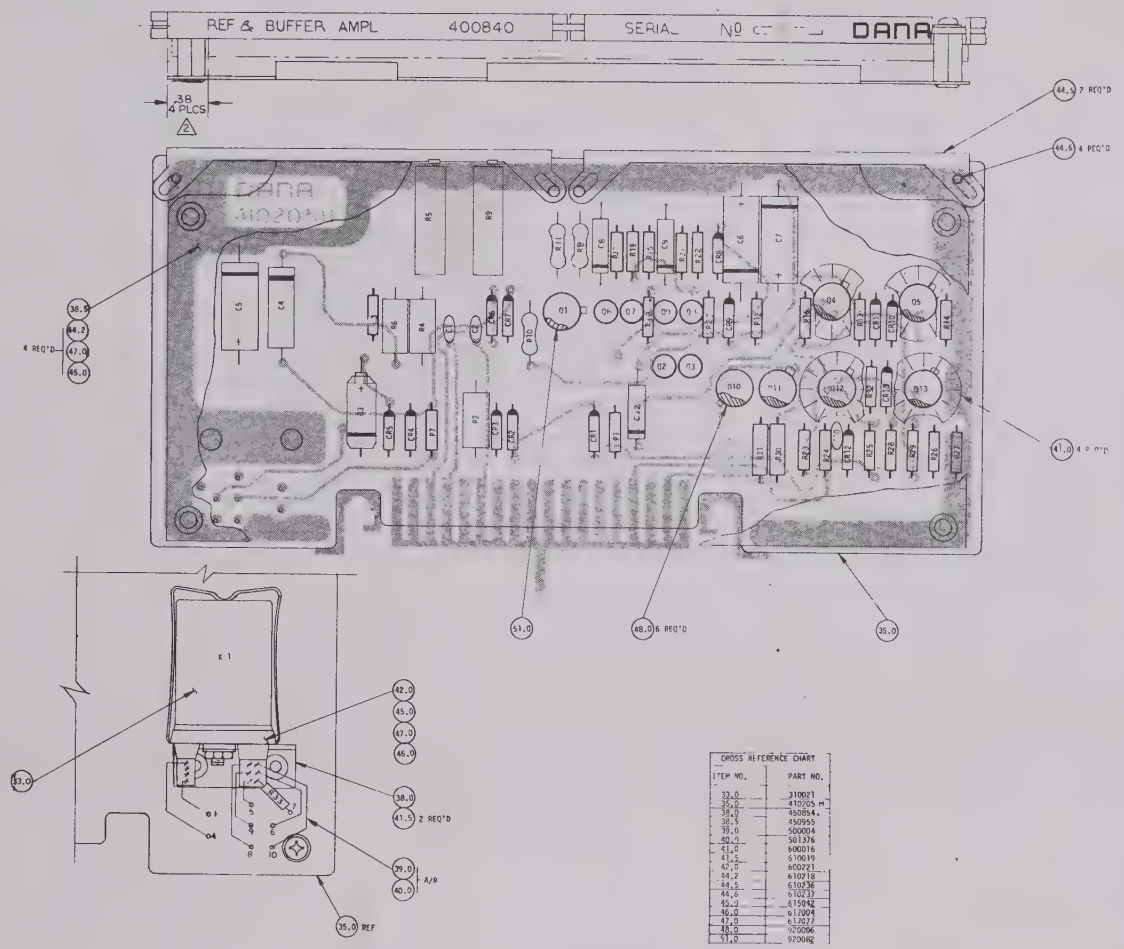
6. Highest lettered referenced designator for logic elements is shown in upper left hand corner of logic schematics.
8. Highest numbered reference designators:
   R 35 C 11
   C 10 CR 38
9. All voltages referenced to digital common
7. All transistors MPS 3638A
8. All resistors 1/4 W. 5%. Carbon.
1. All diodes

NOTES: UNLESS OTHERWISE SPECIFIED:

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES; TOLERANCES ON DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010; ANGLES ± 0° 30'; FORMED ANGLES ± 1.0°; ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR; INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-70327 AND MIL-D-70327	CONTRACT NO.	DANA LABORATORIES INC. IRVINE, CALIFORNIA
APPLIED FINISH		NAME / DATE: DR A. CHAUSSEE 12-27-66; CHK 6 Jan 1967; APPD 1/9/67	SCHEMATIC CONTROL LOGIC MODEL 5400 DWN
HEAT TREATMENT			SIZE D; CODE IDENT NO.; DRWG NO. 430348; SCALE



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
33.0	310021
35.0	410205 M
38.0	450854
38.5	450955
39.0	500004
40.0	501376
41.0	600016
41.5	610019
42.0	600721
44.2	610718
44.5	610236
44.6	610237
45.0	615042
46.0	617004
47.0	617027
48.0	920006
51.0	920082

REF DES	B/M ITEM	DESCRIPTION
R8	14.0	200 K, 1%
R7	12.3	680 ohms
R6	34.0	FSV, 6.10-6.38 K, .1%
R5	16.0	POT - 5 K, E-Z TRIM
R4	34.0	FSV, 3.55-3.83 K, .1%
R3	14.5	30 ohms
R2	34.0	FSV, 200-1000 ohms, 1%
R1	11.0	5.1 K
CR14	30.7	IN96
CR12	30.0	018
CR11	30.0	018
CR10	30.0	018
CR9	32.0	IN9588
CR8	32.0	IN9588
CR7	30.5	007
CR6	30.5	007
CR5	30.0	018
CR4	30.0	018
CR3	34.0	FSV, BRIDGE ELEMENT
CR2	30.5	007
CR1	31.0	IN751
C12	23.5	.0047uf, 100V
C10	20.0	100 pf, DISC
C9	23.0	.001 uf, 100V
C8	23.0	.001 uf, 100V
C7	21.0	25 uf, 50V
C6	21.0	25 uf, 50V
C5	21.0	25 uf, 50V
C4	24.0	.047 uf 100V
C3	22.0	1 uf, 50V
C2	19.5	150 pf, DISC
C1	18.9	330 pf, DISC

REF DES	B/M ITEM	DESCRIPTION
C13	25.0	009
C12	26.0	014
C11	26.0	014
C10	25.0	009
Q9	28.0	2N3565
Q8	28.0	2N3565
Q5	26.0	014
Q4	25.0	009
Q3	28.0	2N3565
Q2	28.0	2N3565
Q1	27.0	016
R33	12.3	680 Ω
R32	7.0	1 K
R31	13.5	1.6 K, 1/2 W
R30	13.5	1.6 K, 1/2 W
R29	6.0	24 ohms
R28	6.0	24 ohms
R27	7.0	2.4 K
R26	7.0	470 Ω
R25	2.0	1 K
R24	10.0	47 K
R23	2.0	1 K
R22	7.0	2.4 K
R21	3.0	1 MEG
R20	11.5	6.2 K
R19	9.0	36 K
R18	11.5	6.2 K
R17	3.0	1 MEG
R16	1.0	100 ohms
R15	7.0	2.4 K
R14	8.0	27 K
R13	1.0	100 ohms
R12	4.0	1.2 K
R11	14.0	200 K, 1%
R10	15.0	182 K, 1%
R9	17.0	POT - 50 K, E-Z TRIM

QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

2 Heat stamp .10 high black characters and .15 high Logo, located as shown.

1. All resistors 1/4 W, ±5%, carbon.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES
X ±.030 ± 0° 30'
XX ±.020
XXX ±.010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL D 1000 AND MIL D 70327

CONTRACT NO.

	NAME	DATE
DR	[illegible]	1-24-66
CHK	[illegible]	10 FEB 1966
APPD	[illegible]	[illegible]

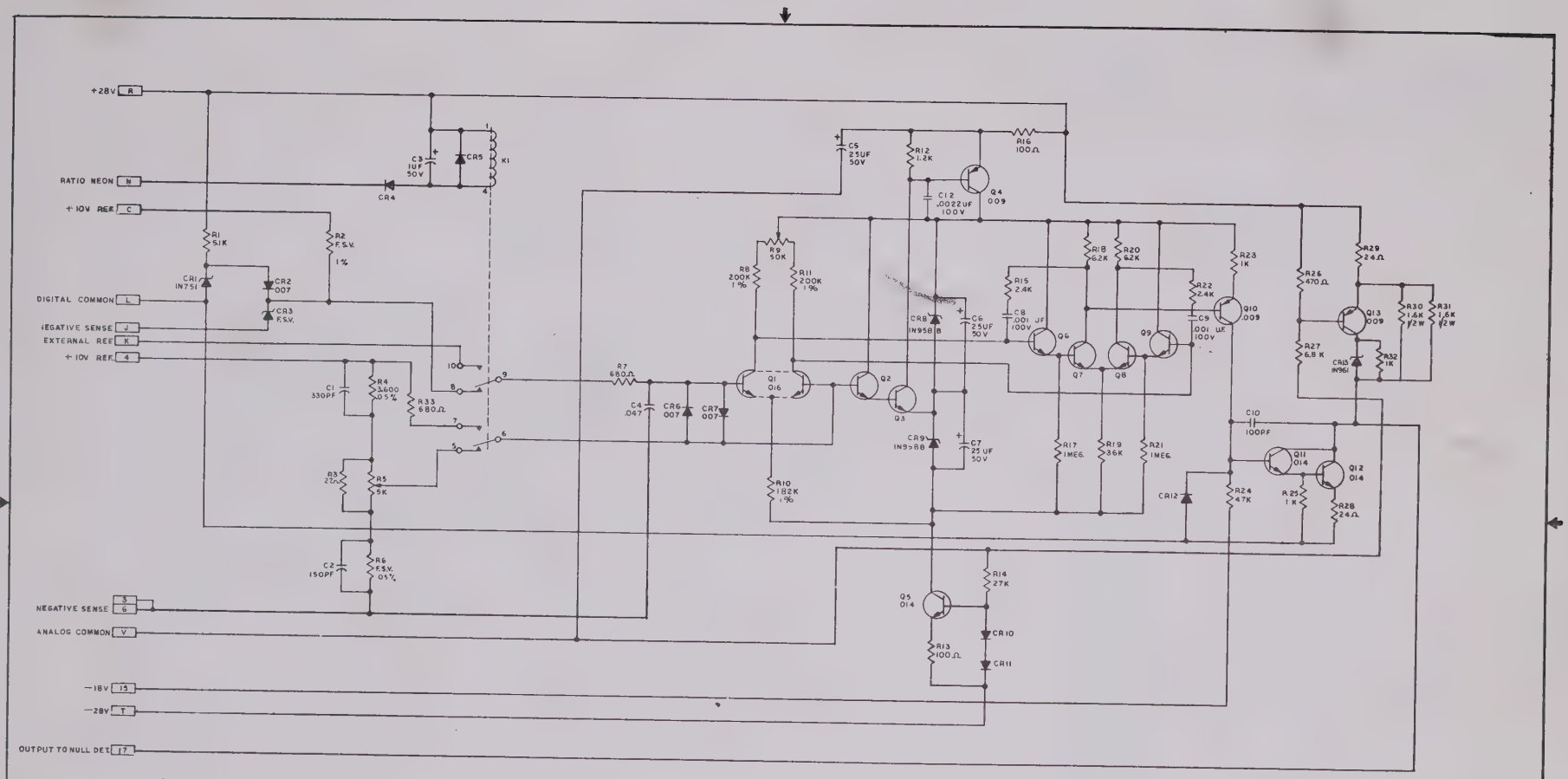
DRN 4421 BD

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY - REFERENCE & BUFFER AMPLIFIER

SIZE	CODE IDENT NO.	DWG NO.	
D	—	400840	K

SCALE 2/1 WT — SHEET 1 OF 1



5. Relay shown in de-energized position
4. Highest numbered reference designators
   R33 Q13
   C15 CR16
3. All transistors, 2N3565
2. All resistors, 1/4W, 5%, Carbon
1. All diodes 018

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .030, XX ± .020, XXX ± .010; ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR A. CHAUSSEE	1-10-66
CHK M. Curtis	JAN 66
APPD J. Nelson	1/13/66

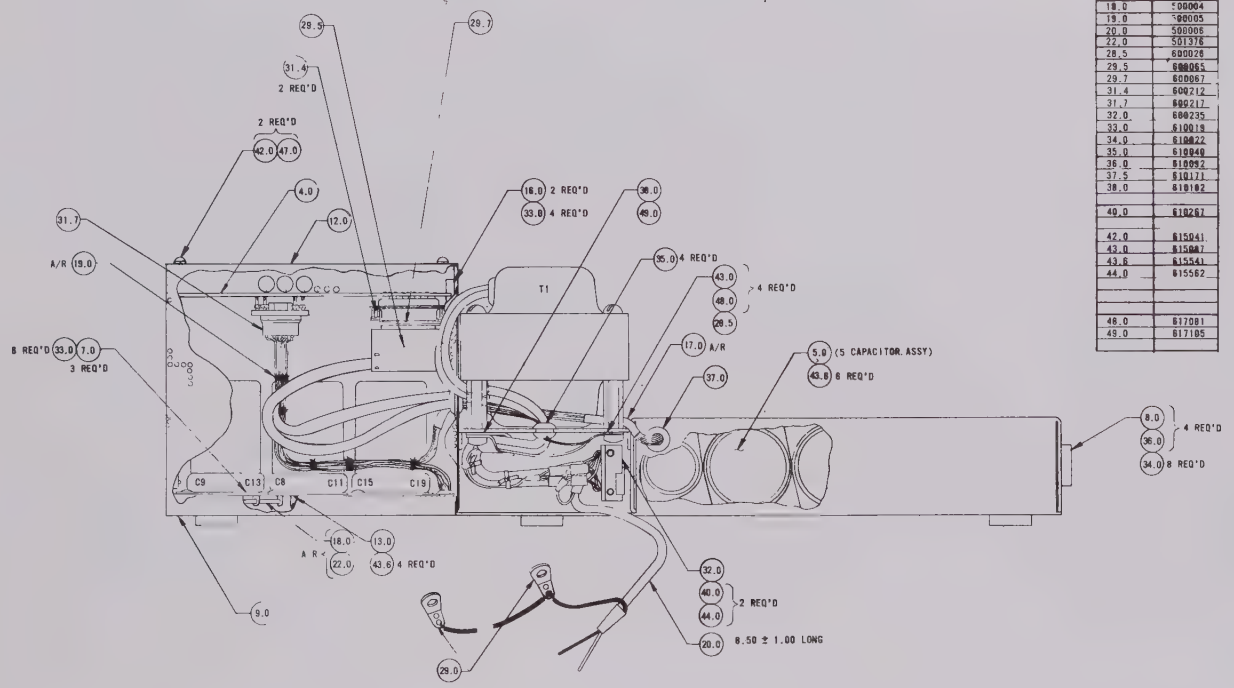
ML 6.10.66
PRN 42-108

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC REFERENCE & BUFFER AMPLIFIER

SIZE D | CODE IDENT NO. | DWG NO. 430350 | F

SCALE — | WT — | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
4.0	400899
5.0	402819
7.0	450188
8.0	450300
9.0	450898
12.0	450894
13.0	450895
18.0	452031
17.0	500002
18.0	500004
19.0	500005
20.0	500006
22.0	501378
28.5	600028
29.5	600065
29.7	600067
31.4	600212
31.7	600217
32.0	600235
33.0	610019
34.0	610022
35.0	610040
36.0	610092
37.5	610171
38.0	610182
40.0	610267
42.0	615041
43.0	615047
43.6	615541
44.0	615562
48.0	617081
49.0	617105

REF DES	B/M ITEM	DESCRIPTION
T1	3.0	300017
C19 C15	1.0	1000UF/35V (DUAL)
C11 C8	1.0	1000UF/35V (DUAL)
C13 C9	1.0	1000UF/35V (DUAL)

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CAGE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: X .030, XX .020, XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN	M. BERG	7 OCT 1966
CHECK	T. WRYE	10 OCT 1966
COG ENGR	M. CURTIS	10 OCT 1966
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

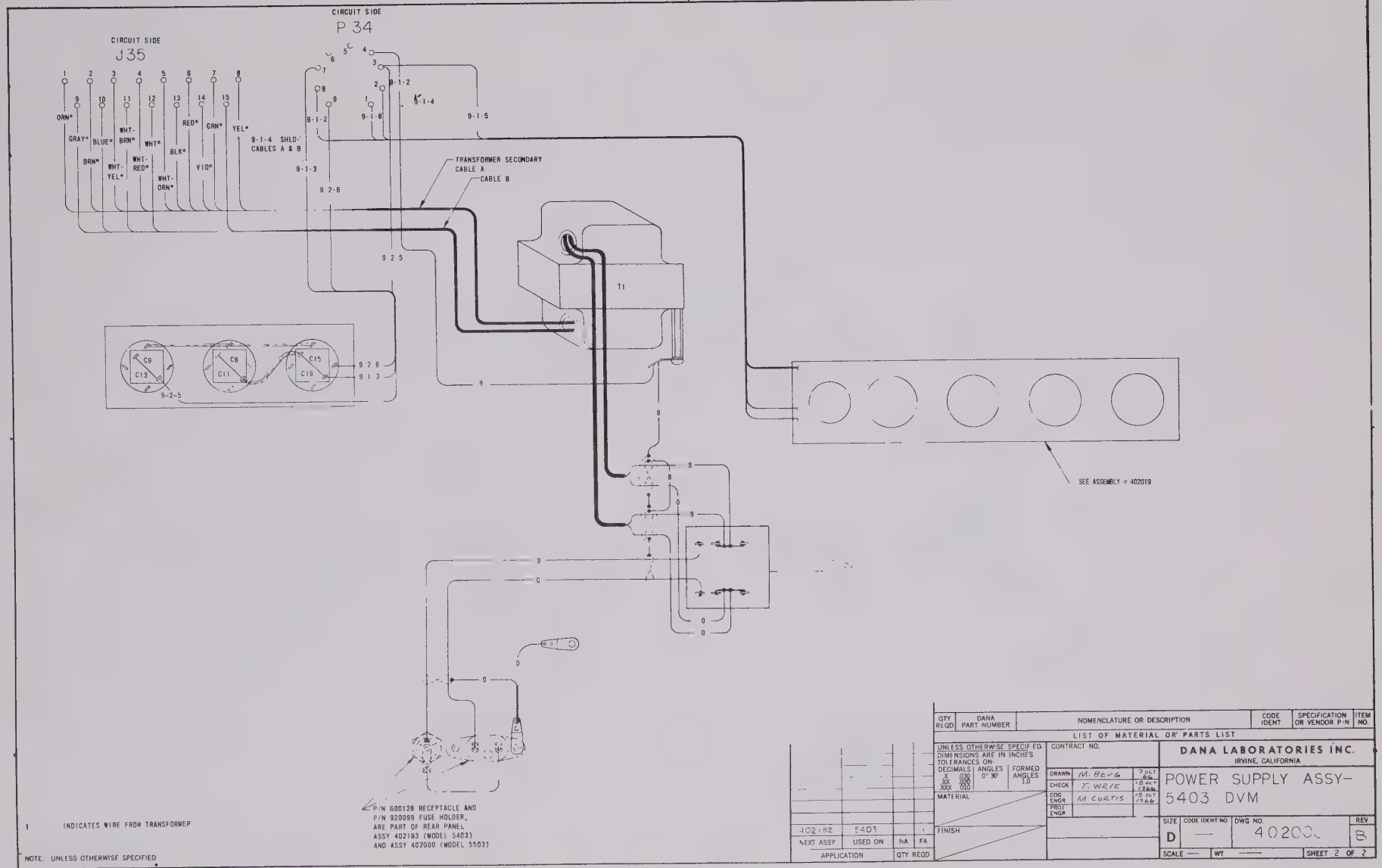
POWER SUPPLY ASSY-
5403 DVM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	----	402000	B

SCALE 1/1 | WT ---- | SHEET 1 OF 2

402182	5403	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
1 [illegible] SCHEMATIC 430[illegible].
NOTE: UNLESS OTHERWISE SPECIFIED



1 INDICATES WIRE FROM TRANSFORMER

NOTE. UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

402182	5403		
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS | ANGLES | FORMED ANGLES
X .030 | 0° 30' | 1.0
XX .010
XXX .010

MATERIAL

FINISH

CONTRACT NO.

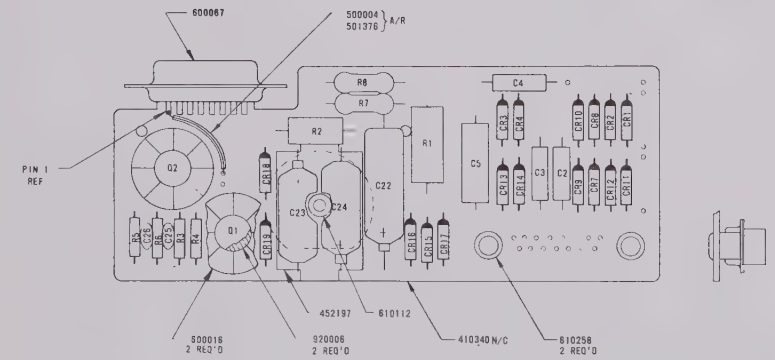
DRAWN	M. BERG	7 OCT 66
CHECK	J. WRIE	18 OCT 1966
COG ENGR	M CURTIS	18 OCT 1966
PROJ ENGR		

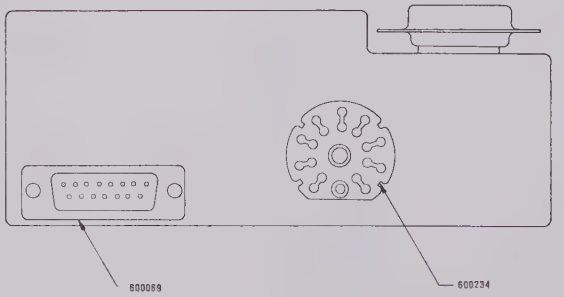
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

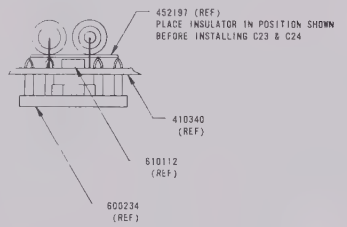
POWER SUPPLY ASSY-
5403 DVM

SIZE	CODE IDENT NO	DWG NO.	REV
D	—	40200	B

SCALE — | WT — | SHEET 2 OF 2







REF DES	PART NO	DESCRIPTION
CR19	220015	1N987B
CR18	220015	1N987B
CR17	210004	SD-4
THRU	↕	↕
CR7		
CR4		
THRU	↕	↕
CR1	210004	SD 4
C26	101174	.001UF DISC
C25	101174	.001UF DISC
C24	110036	25UF/50V
C23	110036	25UF/50V
C22	110041	25UF/6V
C5	120072	.01UF/600V
C4	121088	.01UF/100V
C3	121088	.01UF/100V
C2	121088	.01UF/100V

REF DES	PART NO.	DESCRIPTION
R8	030007	150 OHMS/3W
R7	030007	150 OHMS/3W
R6	000151	150 OHMS
R5	000151	150 OHMS
R4	000202	2 K
R3	000202	2 K
R2	030008	200 OHMS/3W
R1	031450	220 K/2W
Q2	200011	009
Q1	200035	D14

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.
		LIST OF MATERIAL OR PARTS LIST			

402000	5403	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES .X ±.030 0° 30' .XX ±.020 .XXX ±.010 FORMED ANGLES ±1.0

MATERIAL

FINISH

CONTRACT NO.

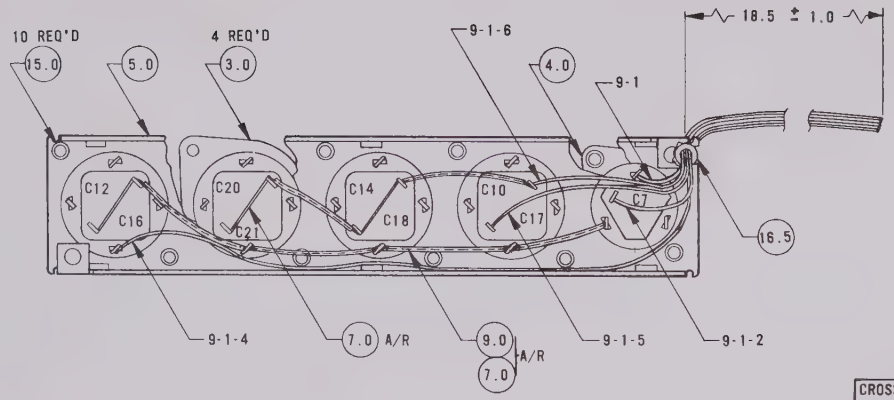
DRAWN	T.T. Ring	12-9-66
CHECK	[illegible]	1-17-67
COG ENGR	[illegible]	1/26/67
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY
POWER SUPPLY

SIZE	CODE IDENT NO.	DWG NO.	REV
D	—	402316	
SCALE 2/1	WT		SHEET 1 OF 1

3 SCHEMATIC REFERENCE: 430571
2 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
1 ALL RESISTORS ARE 1/4 W ± 5%, CARBON
NOTE UNLESS OTHERWISE SPECIFIED



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
3.0	450188
4.0	450918
5.0	450996
7.0	500004
8.0	500005
9.0	501376
15.0	610019
16.5	610158

REF DES	B/M ITEM	DESCRIPTION
C7	2.0	50UF/350V
C16	1.0	1000UF/35V(DUAL)
C12		
C21		
C20		
C18		
C14		
C17	1.0	1000UF/35V(DUAL)
C10		

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.

1. SCHEMATIC REFERENCE: 430399

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON

DECIMALS	ANGLES
.X ± .030	± 0° 30'
.XX ± .020	
.XXX ± .010	

FORMED ANGLES ± 1.0°

ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

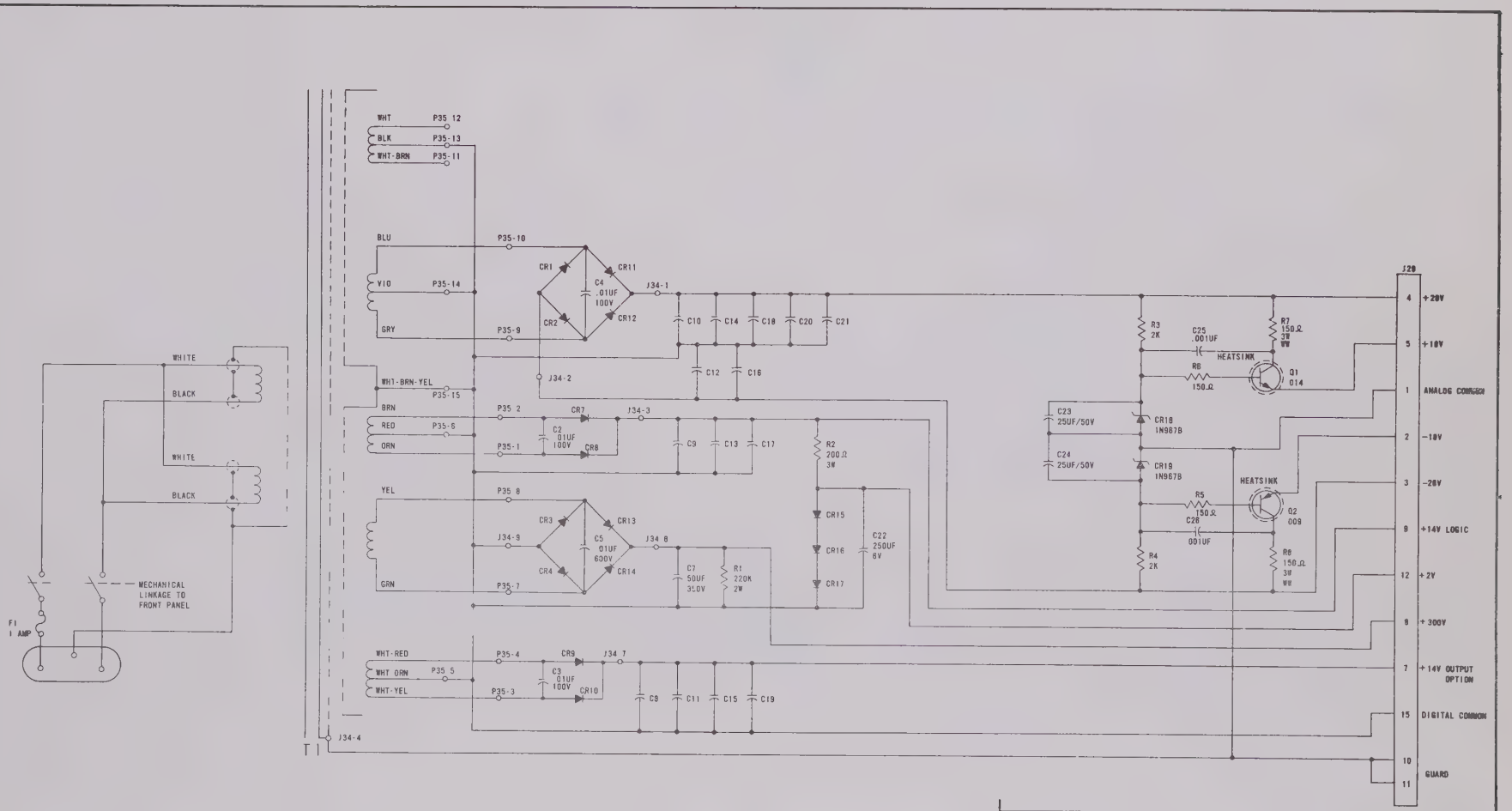
	NAME	DATE
DR	M Berg	10-13-66
CHK	M Curtis	11/13/66
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

CAPACITOR ASSEMBLY-5 CAP

SIZE	CODE IDENT NO.	DWG NO.
C	—	402019

SCALE 1/1 | WT ——— | SHEET 1 OF 1



3. ALL CAPACITORS 1000-MICROFARADS 35 V.
2. ALL DIODES SD 4.
1. ALL RESISTORS 1/4W, CARBON 5%.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

402000	5903	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS X .030 XX .010 XXX .005 | ANGLES 0° 30' | FORMED ANGLES 1.0
MATERIAL
FINISH

CONTRACT NO.

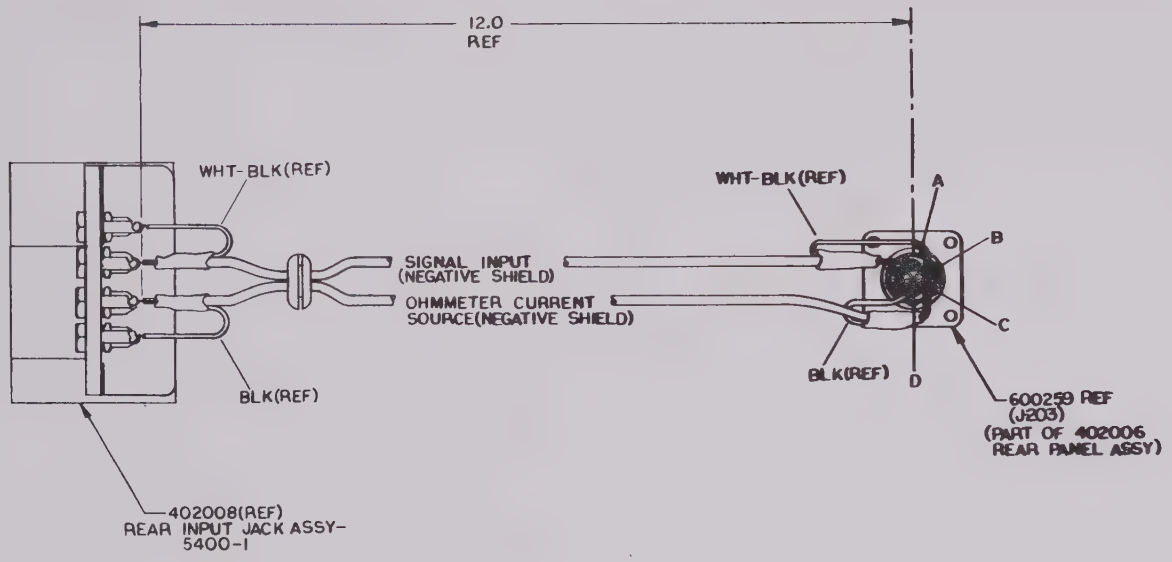
DRAWN	T.J. Berg	12-9-66
CHECK	[illegible]	12-16-66
COG. ENGR	D Payne	12-16-66
PROJ ENGR		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC-
POWER SUPPLY,

SIZE	CODE IDENT NO.	DWG NO.	REV
D	—	430571	
SCALE —	WT —	SHEET 1 OF 1	

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



QTY REQD	SYM	ITEM NO.	GOVT OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

NAME	DATE
DR	26 APR 1962
CHK	
APPD	

Rev 6-17 LL
DPM 0421 BE

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM — ENCLOSURE, 5400-1

SIZE	CODE IDENT NO.	DWG NO.
C	—	430400

SCALE FULL | WT — | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

Recommended Spare Circuit Board Assemblies

Dana Model 5400/020 Digital Voltmeter

Part No.	Description	Kit Number 0853CB001 Stock Level	Kit Number 0853CB002 Stock Level
400688	Sequence Logic Assembly	1	1
400689	Control Logic Assembly	1	1
400840	Reference and Buffer Assembly	1	1
400843	Null Detector Assembly	1	1
400862	Decade Assembly	1	1
400699[1]	Auto Polarity Assembly	1	
402056[2]	Auto Polarity Assembly		1
400700	Isolator Assembly	1	1
402197[3]	Range Control Assembly	1	1

[1] Used in 5400's through serial number 541309.

[2] Used in 5400's serial number 541310 and on.

[3] Replaces part number 400701 Range Control Assembly

Recommended Spare Circuit Board Assemblies

Dana Model 5400/030 Digital Voltmeter

Part No.	Description	Kit Number 0682CB001 Stock Level	Kit Number 0682CB002 Stock Level
400688	Sequence Logic Assembly	1	1
400689	Control Logic Assembly	1	1
400840	Reference and Buffer Assembly	1	1
400843	Null Detector Assembly	1	1
400862	Decade Assembly	1	1
400699[1]	Auto Polarity Assembly	1	0
402056[2]	Auto Polarity Assembly	0	1
400700	Isolator Assembly	1	1
4021973	Range Control Assembly	1	1

[1] Used in 5400's through serial number 541309.

[2] Used in 5400's serial number 541310 and on.

[3] Replaces part number 400701 Range Control Assembly

ATTENUATOR AND CONTROL ASSEMBLY-020 - 400858

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C12	120007	CAP	MYLAR	.22 MFD 600 V 20%	ELEC CUBE	210B1F224
C15	121146	CAP	MYLAR	.0047 MFD 100 V 10%	CDE	WMF1D47
C16	120003	CAP	MYLAR	.1 MFD 100 V 10%	CDE	WMF1P1
K3	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
K4	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
K5	310021	RELAY	DC	2 PDT 24V	ALLIED	AZ42056105
K6	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
R32	010164	RES	METAL	887 K 1% 1 W	ELECTRA	RN70D8873F
R47	010208	RES	METAL	182 K 1% 1/4 W	ELECTRA	RN60D1823F
R50	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J

ATTENUATOR & CONTROL ASSEMBLY-MULTIMETER 030-400698

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C12	120007	CAP	MYLAR	.22 MFD 600 V 20%	ELEC CUBE	210B1F224
C15	524728					
C16	120003	CAP	MYLAR	.1 MFD 100 V 10%	CDE	WMF1P1
K2	310021	RELAY	DC	2 PDT 24V	ALLIED	AZ42056105
K3	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
K4	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
K5	310021	RELAY	DC	2 PDT 24V	ALLIED	AZ42056105
K6	310030	RELAY	DC	4 PDT 28V	PARELCO	INR10-E046
R32	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R47	010208	RES	METAL	182 K 1%	ELECTRA	RN60D1823F
R50	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J

PC BOARD ASSEMBLY ATTENUATOR 040 - 400882

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C13	120089	CAP	MYLAR	4.7 MFD 60 V 10%	IONETICS	1047-60
C14	120089	CAP	MYLAR	4.7 MFD 60 V 10%	IONETICS	1047-60
R30	010020	RES	METAL	4.99 K 1% 1/4 W	ELECTRA	RN60D4991F
R31	010020	RES	METAL	4.99 K 1% 1/4 W	ELECTRA	RN60D4991F
R33	020204	RES	WW	1.1111 K .05% 1/8 W	JORDAN	J-11
R34	020170	RES	WW	100.83 OHM .05% 1/8 W	KELVIN	EP-20
R35	000823	RES	CARBON	82 K 5% 1/4 W	OHMITE	RCO7GF823J
R36	040053	RES	VARI	5 K 10% 1.5 W	CTS	110
R37	000824	RES	CARBON	820 K 5% 1/4 W	OHMITE	RCO7GF824J
R38	040053	RES	VARI	5 K 10% 1.5 W	CTS	110
R39	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RCO7GF153J
R40	000154	RES	CARBON	150 K 5% 1/4 W	OHMITE	RCO7GF154J
R41	010248	RES	WW	99.75 K 1/4% W	IRC	C6618T9
R42	040053	RES	VARI	5 K 10% 1.5 W	CTS	110
R43	010248	RES	WW	99.75 K 1/4% W	IRC	C6618T9
R44	040062	RES	VARI	500 OHM 10% 1.5 W	CTS	110
R45	010248	RES	WW	99.75 K 1/4% W	IRC	C6618T9
R46	010165	RES	METAL	806 K 1% 1/2 W	ELECTRA	RN65D8063F
R48	020166	RES	WW	10 K .05% 1/8 W	JORDAN	LR-11
R49	020166	RES	WW	10 K .05% 1/8 W	JORDAN	LR-11

PC BOARD ASSEMBLY SWITCH PANEL 020 - 402158

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C3	110044	CAP	ELECT	50 MFD 50 V 20%	DUCATI	50-50
C4	120096					
C5	121091	CAP	MYLAR	.033 MFD 100 V 10%	CDE	WMF1533
C6	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
C7	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C8	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C9	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C10	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C11	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
A-CR1	210004	DIODE	SILICO	SD-4		
A-CR2	211083	DIODE	SILICO	018	DANA	211083
B-CR1	211083	DIODE	SILICO	018	DANA	211083
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
A-CR26	210004	DIODE	SILICO	SD-4		
CR26	211083	DIODE	SILICO	018	DANA	211083
CR27	211083	DIODE	SILICO	018	DANA	211083
A-CR27	210004	DIODE	SILICO	SD-4		
A-CR28	210004	DIODE	SILICO	SD-4		
CR28	211083	DIODE	SILICO	018	DANA	211083
CR37 THRU CR44	210004	DIODE	SILICO	SD-4		
CR45	211083	DIODE	SILICO	018	DANA	211083
CR46	211083	DIODE	SILICO	018	DANA	211083
CR48	210004	DIODE	SILICO	SD-4		
CR49	210004	DIODE	SILICO	SD-4		
CR50	211083	DIODE	SILICO	018	DANA	211083
CR51	211083	DIODE	SILICO	018	DANA	211083
K1	310013	RELAY	REED	SPST 24V	WHEELOCK	2961A X6
Q7 THRU Q10	200035	TRANS	SILICO NPN	014	DANA	200035
Q11 THRU Q18	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
R8	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R15	000820	RES	CARBON	82 OHM 5% 1/4 W	OHMITE	RC07GF820J
R16	000514	RES	CARBON	510 K 5% 1/4 W	OHMITE	RC07GF524J
R17	000433	RES	CARBON	43 K 5% 1/4 W	OHMITE	RC07GF433J

PC BOARD ASSEMBLY SWITCH PANEL 020 - 402158

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R18	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R19	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R20	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R21	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R22	000184	RES	CARBON	180	K	5% 1/4 W	OHMITE	RC07GF184J
R23	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R24	000913	RES	CARBON	91	K	5% 1/4 W	OHMITE	RC07GF913J
R25	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J
R26	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R27	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J

PCB ASSEMBLY-SWITCH PANEL - 400704

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C3	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C4	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C5	121091	CAP	MYLAR	.033 MFD 100 V 10%	CDE	WMF1533
C6	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
C7	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C8	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C9	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C10	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C11	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
A-CR1	210004	DIODE	SILICO	SD-4		
A-CR2	210004	DIODE	SILICO	SD-4		
B-CR1	210004	DIODE	SILICO	SD-4		
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
A-CR26	210004	DIODE	SILICO	SD-4		
CR26	211083	DIODE	SILICO	018	DANA	211083
A-CR27	210004	DIODE	SILICO	SD-4		
CR27	211083	DIODE	SILICO	018	DANA	211083
A-CR28	210004	DIODE	SILICO	SD-4		
CR28	211083	DIODE	SILICO	018	DANA	211083
CR37 THRU CR44	210004	DIODE	SILICO	SD-4		
CR46	211083	DIODE	SILICO	018	DANA	211083
CR47	210004	DIODE	SILICO	SD-4		
CR48	210004	DIODE	SILICO	SD-4		
CR49	210004	DIODE	SILICO	SD-4		
CR50	211083	DIODE	SILICO	018	DANA	211083
CR51	211083	DIODE	SILICO	018	DANA	211083
Q7 THRU Q10	200035	TRANS	SILICO NPN	014	DANA	200035
Q11 THRU Q18	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
R8	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R15	000820	RES	CARBON	82 OHM 5% 1/4 W	OHMITE	RC07GF820J
R16	000514	RES	CARBON	510 K 5% 1/4 W	OHMITE	RC07GF524J
R17	000433	RES	CARBON	43 K 5% 1/4 W	OHMITE	RC07GF433J
R18	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J

PC BOARD ASSEMBLY SWITCH PANEL 020 - 402158

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R18	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R19	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R20	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R21	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R22	000184	RES	CARBON	180	K	5% 1/4 W	OHMITE	RC07GF184J
R23	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R24	000913	RES	CARBON	91	K	5% 1/4 W	OHMITE	RC07GF913J
R25	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J
R26	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R27	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J

PCB ASSEMBLY-SWITCH PANEL - 400704

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C3	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C4	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C5	121091	CAP	MYLAR	.033 MFD 100 V 10%	CDE	WMF1533
C6	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
C7	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C8	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C9	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C10	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C11	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
A-CR1	210004	DIODE	SILICO	SD-4		
A-CR2	210004	DIODE	SILICO	SD-4		
B-CR1	210004	DIODE	SILICO	SD-4		
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
A-CR26	210004	DIODE	SILICO	SD-4		
CR26	211083	DIODE	SILICO	018	DANA	211083
A-CR27	210004	DIODE	SILICO	SD-4		
CR27	211083	DIODE	SILICO	018	DANA	211083
A-CR28	210004	DIODE	SILICO	SD-4		
CR28	211083	DIODE	SILICO	018	DANA	211083
CR37 THRU CR44	210004	DIODE	SILICO	SD-4		
CR46	211083	DIODE	SILICO	018	DANA	211083
CR47	210004	DIODE	SILICO	SD-4		
CR48	210004	DIODE	SILICO	SD-4		
CR49	210004	DIODE	SILICO	SD-4		
CR50	211083	DIODE	SILICO	018	DANA	211083
CR51	211083	DIODE	SILICO	018	DANA	211083
Q7 THRU Q10	200035	TRANS	SILICO NPN	014	DANA	200035
Q11 THRU Q18	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
R8	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R15	000820	RES	CARBON	82 OHM 5% 1/4 W	OHMITE	RC07GF820J
R16	000514	RES	CARBON	510 K 5% 1/4 W	OHMITE	RC07GF524J
R17	000433	RES	CARBON	43 K 5% 1/4 W	OHMITE	RC07GF433J
R18	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J

PC BOARD ASSEMBLY SWITCH PANEL 020 - 402158

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
R18	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J
R19	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J
R20	000205	RES	CARBON	2 M 5% 1/4 W	OHMITE	RC07GF205J
R21	000205	RES	CARBON	2 M 5% 1/4 W	OHMITE	RC07GF205J
R22	000184	RES	CARBON	180 K 5% 1/4 W	OHMITE	RC07GF184J
R23	000205	RES	CARBON	2 M 5% 1/4 W	OHMITE	RC07GF205J
R24	000913	RES	CARBON	91 K 5% 1/4 W	OHMITE	RC07GF913J
R25	000912	RES	CARBON	9.1 K 5% 1/4 W	OHMITE	RC07GF912J
R26	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J
R27	000912	RES	CARBON	9.1 K 5% 1/4 W	OHMITE	RC07GF912J

PCB ASSEMBLY-SWITCH PANEL - 400704

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C3	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C4	120026	CAP	MYLAR	.47 MFD 100 V 10%	IMB	AS2B474K
C5	121091	CAP	MYLAR	.033 MFD 100 V 10%	CDE	WMF1533
C6	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
C7	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C8	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C9	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C10	121393	CAP	MYLAR	.22 MFD 100 V 10%	CDE	WMF1P22
C11	121090	CAP	MYLAR	.015 MFD 100 V 10%	CDE	WMF1S15
A-CR1	210004	DIODE	SILICO	SD-4		
A-CR2	210004	DIODE	SILICO	SD-4		
B-CR1	210004	DIODE	SILICO	SD-4		
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
A-CR26	210004	DIODE	SILICO	SD-4		
CR26	211083	DIODE	SILICO	018	DANA	211083
A-CR27	210004	DIODE	SILICO	SD-4		
CR27	211083	DIODE	SILICO	018	DANA	211083
A-CR28	210004	DIODE	SILICO	SD-4		
CR28	211083	DIODE	SILICO	018	DANA	211083
CR37 THRU CR44	210004	DIODE	SILICO	SD-4		
CR46	211083	DIODE	SILICO	018	DANA	211083
CR47	210004	DIODE	SILICO	SD-4		
CR48	210004	DIODE	SILICO	SD-4		
CR49	210004	DIODE	SILICO	SD-4		
CR50	211083	DIODE	SILICO	018	DANA	211083
CR51	211083	DIODE	SILICO	018	DANA	211083
Q7	200035	TRANS	SILICO NPN	014	DANA	200035
Q7 THRU Q10	200035	TRANS	SILICO NPN	014	DANA	200035
Q11	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q11 THRU Q18	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
R8	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R15	000820	RES	CARBON	82 OHM 5% 1/4 W	OHMITE	RC07GF820J
R16	000514	RES	CARBON	510 K 5% 1/4 W	OHMITE	RC07GF524J
R17	000433	RES	CARBON	43 K 5% 1/4 W	OHMITE	RC07GF433J
R18	000105	RES	CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J

PCB ASSEMBLY-SWITCH PANEL - 400704

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R19	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R20	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R21	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R22	000184	RES	CARBON	180	K	5% 1/4 W	OHMITE	RC07GF184J
R23	000205	RES	CARBON	2	M	5% 1/4 W	OHMITE	RC07GF205J
R24	000913	RES	CARBON	91	K	5% 1/4 W	OHMITE	RC07GF913J
R25	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J
R26	000105	RES	CARBON	1	M	5% 1/4 W	OHMITE	RC07GF105J
R27	000912	RES	CARBON	9.1	K	5% 1/4 W	OHMITE	RC07GF912J

PCB ASSEMBLY ISOLATOR-4C07CC

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	120004	CAP	POLYS	.001 MFD 500 V 5%	CRL	CPR-10C0J
C2	121146	CAP	MYLAR	.0047 MFD 100 V 10%	CDE	WMF1D47
C3	120063	CAP	MYLAR	2 MFD 100 V 5%	IMB	XT2B205J
C4	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C5	120003	CAP	MYLAR	.1 MFD 100 V 10%	CDE	WMF1P1
C6	110038	CAP	ELECT	50 MFD 15 V 20%	DUCATI	50-15
C7	120003	CAP	MYLAR	.1 MFD 100 V 10%	CDE	WMF1P1
C8	110039	CAP	ELECT	5 MFD 50 V 20%	DUCATI	5-50
C9	110038	CAP	ELECT	50 MFD 15 V 20%	DUCATI	50-15
C10	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C11	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C12	100013	CAP	CERAM	15 PFD 500 V 10%	AEROVOX	TCD-N750
C13	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
CR1	200048	TRANS	SILICO	NPN DUAL 2N3565		
CR2	200048	TRANS	SILICO	NPN DUAL 2N3565		
CR3	211236					
CR4	211236					
CR5	211083	DIODE	SILICO	018	DANA	211083
CR6	220012	DIODE	SILICO	ZENER 1N958B	MOTOROLA	1N958B
CR7	211083	DIODE	SILICO	018	DANA	211083
CR8	211083	DIODE	SILICO	018	DANA	211083
CR9	220012	DIODE	SILICO	ZENER 1N958B	MOTOROLA	1N958B
CR10 THRU	211083	DIODE	SILICO	018	DANA	211083
CR15	211083	DIODE	SILICO	018	DANA	211083
CR16	211126	DIODE	SILICO	004	DANA	211126
CR17	211126	DIODE	SILICO	004	DANA	211126
CR18	220020	DIODE	SILICO	ZENER 1N4370	MOTOROLA	1N4370
Q1	200036	TRANS	SILICO	NPN 015	DANA	200036
Q2	200063					
Q3	201084	TRANS	GERMAN	PNP 2N1304	TI	2N1304
Q4	200063					
Q5	200044					
Q6	200044					
Q7	200022	TRANS	SILICO	PNP 012	DANA	200022
Q8	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q9	200035	TRANS	SILICO	NPN 014	DANA	200035
Q10	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q11	200052	TRANS	SILICO	PNP 009	DANA	200052

PCB ASSEMBLY ISOLATOR-400700

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION				MANUFAC	MANUFAC P/N
Q12	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q13	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q14	200022	TRANS	SILICO PNP	012				DANA	200022
Q15	200035	TRANS	SILICO NPN	014				DANA	200035
Q16	020003	RES	METAL	1.17 K		.5%	W		
R1	010249	RES	WW	25	M	2%	1/8 W	DALE	DC-2
R2	000623	RES	CARBON	62	K	5%	1/4 W	OHMITE	RC07GF623J
R3	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R4	000152	RES	CARBON	1.5	K	5%	1/4 W	OHMITE	RC07GF152J
R5	000622	RES	CARBON	6.2	K	5%	1/4 W	OHMITE	RC07GF622J
R6	040050	RES	VARI	5	K	10%	1/2 W	BOURNS	3067-P-1-K02
R7	000152	RES	CARBON	1.5	K	5%	1/4 W	OHMITE	RC07GF152J
R8	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R9	000242	RES	CARBON	2.4	K	5%	1/4 W	OHMITE	RC07GF242J
R10	010309								
R11	000124	RES	CARBON	120	K	5%	1/4 W	OHMITE	RC07GF124J
R12	011178								
R13	040055	RES	VARI	500	K	10%	1/5 W	BOURNS	3068-P-1-504
R14	000335	RES	CARBON	3.3	M	5%	1/4 W	OHMITE	RC07GF335J
R15	040057	RES	VARI	250	K	20%	1/4 W	CTS	45
R16	011178								
R17	040053	RES	VARI	5	K	10%	1.5 W	CTS	110
R18	000752	RES	CARBON	7.5	K	5%	1/4 W	OHMITE	RC07GF752J
R19	000750	RES	CARBON	75	OHM	5%	1/4 W	OHMITE	RC07GF750J
R20	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R21	000912	RES	CARBON	9.1	K	5%	1/4 W	OHMITE	RC07GF912J
R22	000393	RES	CARBON	39	K	5%	1/4 W	OHMITE	RC07GF393J
R23	000335	RES	CARBON	3.3	M	5%	1/4 W	OHMITE	RC07GF335J
R24	000102	RES	CARBON	1	K	5%	1/4 W	OHMITE	RC07GF102J
R25	000433	RES	CARBON	43	K	5%	1/4 W	OHMITE	RC07GF433J
R26	000153	RES	CARBON	15	K	5%	1/4 W	OHMITE	RC07GF153J
R27	000912	RES	CARBON	9.1	K	5%	1/4 W	OHMITE	RC07GF912J
R28	000912	RES	CARBON	9.1	K	5%	1/4 W	OHMITE	RC07GF912J
R29	000240	RES	CARBON	24	OHM	5%	1/4 W	OHMITE	RC07GF240J
R30	000750	RES	CARBON	75	OHM	5%	1/4 W	OHMITE	RC07GF750J
R31	000122	RES	CARBON	1.2	K	5%	1/4 W	OHMITE	RC07GF122J
R32	000513	RES	CARBON	51	K	5%	1/4 W	OHMITE	RC07GF513J
R33	000332	RES	CARBON	3.3	K	5%	1/4 W	OHMITE	RC07GF332J
R34	000511	RES	CARBON	510	OHM	5%	1/4 W	OHMITE	RC07GF511J
R35	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J

PCB ASSEMBLY ISOLATOR-400700

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R36	000240	RES	CARBON	24	OHM	5% 1/4 W	OHMITE	RC07GF240J
R37	000565	RES	CARBON	5.6	M	5% 1/4 W	OHMITE	RC07GF565J
R38	C00136	RES	CARBON	13	M	5% 1/4 W	OHMITE	RC07GF136J
R39	000132	RES	CARBON	1.3	K	5% 1/4 W	OHMITE	RC07GF132J
R40	000153	RES	CARBON	15	K	5% 1/4 W	OHMITE	RC07GF153J
R41	000472	RES	CARBON	4.7	K	5% 1/4 W	OHMITE	RC07GF472J
R42	000101	RES	CARBON	100	OHM	5% 1/4 W	OHMITE	RC07GF101J

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	101174	CAP	CERAM	.001 MFD 500 V 10%	AEROVOX	SCD3X5F
E-C1	121092	CAP	MYLAR	.0022 MFD 100 V 10%	CDE	WMF1D22
C3	121092	CAP	MYLAR	.0022 MFD 100 V 10%	CDE	WMF1D22
CR1	211083	DIODE	SILICO	018	DANA	211083
CR2	211083	DIODE	SILICO	018	DANA	211083
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
ACR1 THRU	210004	DIODE	SILICO	SD-4		
ACR5	210004	DIODE	SILICO	SD-4		
BCR2	210004	DIODE	SILICO	SD-4		
KCR2	210004	DIODE	SILICO	SD-4		
LCR2	210004	DIODE	SILICO	SD-4		
MCR3	210004	DIODE	SILICO	SD-4		
CR25	211083	DIODE	SILICO	018	DANA	211083
CR26	210004	DIODE	SILICO	SD-4		
CR27	210004	DIODE	SILICO	SD-4		
CR28	210004	DIODE	SILICO	SD-4		
CR38	210004	DIODE	SILICO	SD-4		
CR37	210004	DIODE	SILICO	SD-4		
CR39	210004	DIODE	SILICO	SD-4		
CR40	210004	DIODE	SILICO	SD-4		
CR41	211083	DIODE	SILICO	018	DANA	211083
Q3	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q4	200035	TRANS	SILICO	NPN 014	DANA	200035
Q7 THRU	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q11	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
R5	000822	RES	CARBON	8.2 K 5% 1/4 W	OHMITE	RC07GF822J
R7	000204	RES	CARBON	200 K 5% 1/4 W	OHMITE	RC07GF204J
R8	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J
R10	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
R16	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R17	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R18	000512	RES	CARBON	5.1 K 5% 1/4 W	OHMITE	RC07GF512J
R17	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R19	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R20	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R21	000512	RES	CARBON	5.1 K 5% 1/4 W	OHMITE	RC07GF512J
R22	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J

PCB APCB ASSEMBLY RANGE CONTROL - 402197

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION		MANUFAC	MANUFAC P/N
R23	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J
R24	000104	RES	CARBON	100 K	5% 1/4 W	OHMITE	RC07GF104J
C-R8	000123	RES	CARBON	12 K	5% 1/4 W	OHMITE	RC07GF123J
D-R8	000123	RES	CARBON	12 K	5% 1/4 W	OHMITE	RC07GF123J
E-R8	000512	RES	CARBON	5.1 K	5% 1/4 W	OHMITE	RC07GF512J
F-R8	000512	RES	CARBON	5.1 K	5% 1/4 W	OHMITE	RC07GF512J
J-R8	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J
K-R8	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J
L-R8	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J
M-R8	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J
P-R8	000822	RES	CARBON	8.2 K	5% 1/4 W	OHMITE	RC07GF822J

PCB APCB ASSEMBLY AUTO POLARITY - 402056

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	120039	CAP	POLYS	24 PFD 500 V 5%	CRL	CPR-24J
C2	120039	CAP	POLYS	24 PFD 500 V 5%	CRL	CPR-24J
C3	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C4	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C5	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C6	110039	CAP	ELECT	5 MFD 50 V 20%	DUCATI	5-50
C7	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C8	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C10	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C11	101098	CAP	CERAM	330 PFD 500 V 10%	AEROVOX	SCD1X5F
C12	101098	CAP	CERAM	330 PFD 500 V 10%	AEROVOX	SCD1X5F
CR1 THRU	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
CR5	210006	DIODE	SILICO	S368	G.E.	S368
CR6	210006	DIODE	SILICO	S368	G.E.	S368
CR7 THRU	211083	DIODE	SILICO	018	DANA	211083
CR10	211083	DIODE	SILICO	018	DANA	211083
CR11	221177	DIODE	SILICO ZENER	1/4 W	MOTOROLA	M.2.4A25
Q1	200040	TRANS	SILICO NPN	016	DANA	200040
Q2	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q3	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q4	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q5	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q6	200011	TRANS	SILICO PNP	009	DANA	200011
Q7	200035	TRANS	SILICO NPN	014	DANA	200035
Q8	200035	TRANS	SILICO NPN	014	DANA	200035
Q9	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q10	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q11	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q12	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
R1	000202	RES	CARBON	2 K 5% 1/4 W	OHMITE	RC07GF202J
R2	010137	RES	METAL	100 OHM 1% 1/4 W	ELECTRA	RN60D1000F
R3	040050	RES	VARI	5 K 10% 1/2 W	BOURNS	3067-P-1-502
R4	000393	RES	CARBON	39 K 5% 1/4 W	OHMITE	RC07GF393J
R5	020166	RES	WW	10 K .05% 1/8 W	JORDAN	LR-11
R6	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J
R7	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J

PCB APCB ASSEMBLY AUTO POLARITY - 402056

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R8	020166	RES	ww	10 K	.05%	1/8 W	JORDAN	LR-11
R9	010038	RES	METAL	422 K	1%	1/4 W	ELECTRA	RN60D4223F
R10	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R11	040054	RES	VARI	50 K	10%	1/5 W	BOURNS	3068-P-1503
R12	010038	RES	METAL	422 K	1%	1/4 W	ELECTRA	RN60D4223F
R13	000184	RES	CARBON	180 K	5%	1/4 W	OHMITE	RC07GF184J
R14	000184	RES	CARBON	180 K	5%	1/4 W	OHMITE	RC07GF184J
R15	000102	RES	CARBON	1 K	5%	1/4 W	OHMITE	RC07GF102J
R17	010137	RES	METAL	100 OHM	1%	1/4 W	ELECTRA	RN60D1000F
R18	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R19	000910	RES	CARBON	91 OHM	5%	1/4 W	OHMITE	RC07GF910J
R20	000472	RES	CARBON	4.7 K	5%	1/4 W	OHMITE	RC07GF472J
R21	000910	RES	CARBON	91 OHM	5%	1/4 W	OHMITE	RC07GF910J
R22	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R23	000201	RES	CARBON	200 OHM	5%	1/4 W	OHMITE	RC07GF201J
R24	000470	RES	CARBON	47 OHM	5%	1/4 W	OHMITE	RC07GF470J
R25	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R26	000183	RES	CARBON	18 K	5%	1/4 W	OHMITE	RC07GF183J
R27	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R28	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R29	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R32	000163	RES	CARBON	16 K	5%	1/4 W	OHMITE	RC07GF163J
R33	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R34	000163	RES	CARBON	16 K	5%	1/4 W	OHMITE	RC07GF163J
R35	000303	RES	CARBON	30 K	5%	1/4 W	OHMITE	RC07GF303J
R36	020166	RES	ww	10 K	.05%	1/8 W	JORDAN	LR-11
R37	000391	RES	CARBON	390 OHM	5%	1/4 W	OHMITE	RC07GF391J

PC BOARD ASSEMBLY AC CONVERTER 400706

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	130033	CAP	GLASS	6.8 PFD 500 V 10%	CORN	CYFN-10C6R8
C2	130029	CAP	GLASS	1-5 PFD 500 V 10%	LRC	682116
C3	110017	CAP	TANTA	1 MFD 35 V 10%	KEMET	K1C35K
C4	110038	CAP	ELECT	50 MFD 15 V 20%	DUCATI	50-15
C5	110001	CAP	TANTA	6.8 MFD 35 V 10%	KEMET	K6R8C35K
C6	101641	CAP	CERAM	470 PFD 500 V 10%	AEROVOX	SCD1X5F
C7	130039	CAP	GLASS	27 PFD 500 V 10%	CORN	CYFM10C270J
C8	130029	CAP	GLASS	1-5 PFD 500 V 10%	LRC	682116
C9	100006	CAP	CERAM	10 PFD 500 V 10%	AEROVOX	TCD-N750
C10	130034	CAP	CERAM	7-45 PFD 500 V 10%	CRL	822BN-N650
C11	130040	CAP	GLASS	240 PFD 300 V 10%	CORN	CYFM10C241J
C12	FSV					
C13	130041	CAP	GLASS	3000 PFD 500 V 10%	CORN	CYFM200302J
C14	100006	CAP	CERAM	10 PFD 500 V 10%	AEROVOX	TCD-N750
C15	101641	CAP	CERAM	470 PFD 500 V 10%	AEROVOX	SCD1X5F
C16	110001	CAP	TANTA	6.8 MFD 35 V 10%	KEMET	K6R8C35K
C17	100005	CAP	CERAM	22 PFD 500 V 10%	AEROVOX	TCD-N750
C18	110001	CAP	TANTA	6.8 MFD 35 V 10%	KEMET	K6R8C35K
C19	110002	CAP	TANTA	22 MFD 35 V 10%	KEMET	K22C35K
C20	110001	CAP	TANTA	6.8 MFD 35 V 10%	KEMET	K6R8C35K
C21	120069	CAP	MYLAR	.39 MFD 100 V 10%	IMB	XA1134K
C22	130034	CAP	CERAM	7-45 PFD 500 V 10%	CRL	822BN-N650
CR1 THRU	211083	DIODE	SILICO	018	DANA	211083
CR8	211083	DIODE	SILICO	018	DANA	211083
CR9	220004	DIODE	SILICO	ZENER 1N961B	MOTOROLA	1N961B
CR10	211083	DIODE	SILICO	018	DANA	211083
CR11	211083	DIODE	SILICO	018	DANA	211083
CR12	210004	DIODE	SILICO	SD-4		
CR13	210004	DIODE	SILICO	SD-4		
CR14	210004	DIODE	SILICO	SD-4		
Q1	200035	TRANS	SILICO	NPN 014	DANA	200035
Q2	200035	TRANS	SILICO	NPN 014	DANA	200035
Q3	200035	TRANS	SILICO	NPN 014	DANA	200035
Q4	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q5	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q6	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q7	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q8	200043	TRANS	SILICO	NPN 2N3565	FAIRCHILD	2N3565
Q9	200011	TRANS	SILICO	PNP 009	DANA	200011

PC BOARD ASSEMBLY AC CONVERTER 400706

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION				MANUFAC	MANUFAC P/N
Q10	200035	TRANS	SILICO NPN	014				DANA	200035
K1	310013	RELAY	REED	SPST	24V			WHEELOCK	2961A X6
K2	310013	RELAY	REED	SPST	24V			WHEELOCK	2961A X6
K3	310022	RELAY	DC	4 PDT	29V			ALLIED	TS154-0C-CC
R1	000473	RES	CARBON	47 K	5%	1/4	W	OHMITE	RC07GF473J
R2	010380								
R3	000473	RES	CARBON	47 K	5%	1/4	W	OHMITE	RC07GF473J
R4	000684	RES	CARBON	680 K	5%	1/4	W	OHMITE	RC07GF684J
R5	000101	RES	CARBON	100 OHM	5%	1/4	W	OHMITE	RC07GF101J
R6	000913	RES	CARBON	91 K	5%	1/4	W	OHMITE	RC07GF913J
R7	000470	RES	CARBON	47 OHM	5%	1/4	W	OHMITE	RC07GF470J
R8	000682	RES	CARBON	6.8 K	5%	1/4	W	OHMITE	RC07GF682J
R9	000272	RES	CARBON	2.7 K	5%	1/4	W	OHMITE	RC07GF272J
R10	000201	RES	CARBON	200 OHM	5%	1/4	W	OHMITE	RC07GF201J
R11	010280	RES	WW	3.319 K	.25%	1/8	W	PME	PME3319KT2
R12	000913	RES	CARBON	91 K	5%	1/4	W	OHMITE	RC07GF913J
R13	010280	RES	WW	3.319 K	.25%	1/8	W	PME	PME3319KT2
R14	010280	RES	WW	3.319 K	.25%	1/8	W	PME	PME3319KT2
R15	000152	RES	CARBON	1.5 K	5%	1/4	W	OHMITE	RC07GF152J
R16	000201	RES	CARBON	200 OHM	5%	1/4	W	OHMITE	RC07GF201J
R17	000392	RES	CARBON	0003.9 K	5%	1/4	W	OHMITE	RC07GF392J
R18	040053	RES	VARI	5 K	10%	1.5	W	CTS	110
R19	040062	RES	VARI	500 OHM	10%	1.5	W	CTS	110
R20	040052	RES	VARI	50 OHM	10%	1.5	W	CTS	110
R21	000153	RES	CARBON	15 K	5%	1/4	W	OHMITE	RC07GF153J
R22	000330	RES	CARBON	33 K	5%	1/4	W	OHMITE	RC07GF330J
R23	000751	RES	CARBON	750 OHM	5%	1/4	W	OHMITE	RC07GF751J
R24	000330	RES	CARBON	33 K	5%	1/4	W	OHMITE	RC07GF330J
R25	000432	RES	CARBON	4.3 K	5%	1/4	W	OHMITE	RC07GF432J
R26	000103	RES	CARBON	10 K	5%	1/4	W	OHMITE	RC07GF103J
R27	000910	RES	CARBON	91 OHM	5%	1/4	W	OHMITE	RC07GF910J
R28	000390	RES	CARBON	39 OHM	5%	1/4	W	OHMITE	RC07GF390J
R29	020165	RES	WW	270 K	1%	1/8	W	KELVIN	EP-20
R30	020165	RES	WW	270 K	1%	1/8	W	KELVIN	EP-20
R31	020164	RES	WW	135 K	.1%	1/8	W	KELVIN	EP-20
R32	020164	RES	WW	135 K	.1%	1/8	W	KELVIN	EP-20
R33	000202	RES	CARBON	2 K	5%	1/4	W	OHMITE	RC07GF202J
R34	001705	RES	CARBON	820 OHM	5%	1/2	W	OHMITE	RC20GF821J
R35	000152	RES	CARBON	1.5 K	5%	1/4	W	OHMITE	RC07GF152J

PCB APCB ASSEMBLY OHMS CONVERTER - 400705

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	110040	CAP	ELECT	1 MFD 50 V 20%	DUCATI	1-50
C2	121146	CAP	MYLAR	.0047 MFD 100 V 10%	CDE	WMF1D47
C3	101174	CAP	CERAM	.001 MFD 500 V 10%	AEROVOX	SCD3X5F
C4	101174	CAP	CERAM	.001 MFD 500 V 10%	AEROVOX	SCD3X5F
C5	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
CR1	211083	DIODE	SILICO	018	DANA	211083
CR2	211083	DIODE	SILICO	018	DANA	211083
CR3	211083	DIODE	SILICO	018	DANA	211083
CR13	211083	DIODE	SILICO	018	DANA	211083
THRU						
CR16	211083	DIODE	SILICO	018	DANA	211083
CR17	221177	DIODE	SILICO ZENER	1/4 W	MOTOROLA	M.2.4A25
CR18	210004	DIODE	SILICO	SD-4		
CR19	210004	DIODE	SILICO	SD-4		
Q1	200035	TRANS	SILICO NPN	014	DANA	200035
THRU						
Q4	200035	TRANS	SILICO NPN	014	DANA	200035
Q6	200040	TRANS	SILICO NPN	016	DANA	200040
Q7	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
THRU						
Q12	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565
Q13	200011	TRANS	SILICO PNP	009	DANA	200011
R2	010289	RES	METAL	555.5 K .1% 1/2 W	PYROFILM	PME65T2
R3	040054	RES	VARI	50 K 10% 1/5 W	BOURNS	3068-P-1503
R4	020241	RES	WW	10 K .05% 1/8 W	JORDAN	J-11
R5	020237	RES	WW	5.02 K .05% 1/8 W	JORDAN	J-11
R6	020237	RES	WW	5.02 K .05% 1/8 W	JORDAN	J-11
R7	020241	RES	WW	10 K .05% 1/8 W	JORDAN	J-11
R8	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R9	010289	RES	METAL	555.5 K .1% 1/2 W	PYROFILM	PME65T2
R10	040053	RES	VARI	5 K 10% 1.5 W	CTS	110
R11	010246	RES	METAL	54.9 K 1% 1/4 W	ELECTRA	RN60D5492F
R12	040005	RES	VARI	10 K 10% 1/2 W	BOURNS	3067-P-1-103
R13	010246	RES	METAL	54.9 K 1% 1/4 W	ELECTRA	RN60D5492F
R14	000242	RES	CARBON	2.4 K 5% 1/4 W	OHMITE	RC07GF242J
R15	020238	RES	WW	50.5 K .1% 1/8 W	JORDAN	J-11
R16	040062	RES	VARI	500 OHM 10% 1.5 W	CTS	110
R17	000623	RES	CARBON	62 K 5% 1/4 W	OHMITE	RC07GF623J
R18	000152	RES	CARBON	1.5 K 5% 1/4 W	OHMITE	RC07GF152J

PCB APCB ASSEMBLY OHMS CONVERTER - 400705

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION				MANUFAC	MANUFAC P/N
R19	020239	RES	WW	5.0005	K	.1%	1/8 W	JORDAN	J-11
R20	040052	RES	VARI	50	OHM	10%	1.5 W	CTS	110
R21	000202	RES	CARBON	2	K	5%	1/4 W	OHMITE	RC07GF202J
R22	020241	RES	WW	10	K	.05%	1/8 W	JORDAN	J-11
R23	040051	RES	VARI	5	OHM	10%	1.5 W	CTS	110
R24	000163	RES	CARBON	16	K	5%	1/4 W	OHMITE	RC07GF163J
R25	000163	RES	CARBON	16	K	5%	1/4 W	OHMITE	RC07GF163J
R26	000101	RES	CARBON	100	OHM	5%	1/4 W	OHMITE	RC07GF101J
R27	000912	RES	CARBON	9.1	K	5%	1/4 W	OHMITE	RC07GF912J
R28	000100	RES	CARBON	10	OHM	5%	1/4 W	OHMITE	RC07GF100J

PCB APCB ASSEMBLY DISPLAY- 400691

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
C1	110041	CAP	ELECT	250 MFD	6 V	20%	DUCATI	250-6
CR1	210004	DIODE	SILICO	SD-4				
CR2	210004	DIODE	SILICO	SD-4				
CR3	210004	DIODE	SILICO	SD-4				
CR4	210004	DIODE	SILICO	SD-4				
R1	001107	RES	CARBON	39 K	5%	1 W	OHMITE	RC32GF393J
R2	001698	RES	CARBON	20 K	5%	1 W	OHMITE	RC32GF203J
R3	000224	RES	CARBON	220 K	5%	1/4 W	OHMITE	RC07GF224J
R4	001107	RES	CARBON	39 K	5%	1 W	OHMITE	RC32GF393J
R5	001698	RES	CARBON	20 K	5%	1 W	OHMITE	RC32GF203J
R6 THRU R12	030005	RES	CARBON	100 K		2 W		
R13 THRU R19	030006	RES	CARBON	100 K		1 W		

PCB APCB ASSEMBLY DECADE, BCD, BASIC - 400862

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	100012	CAP	CERAM	33 PFD 500 V 10%	AEROVOX	TCD-N750
CR1	211083	DIODE	SILICO	018	DANA	211083
CR2	211083	DIODE	SILICO	018	DANA	211083
CR3	211083	DIODE	SILICO	018	DANA	211083
CR4	211083	DIODE	SILICO	018	DANA	211083
CR25	211083	DIODE	SILICO	018	DANA	211083
CR36 THRU CR48	211083	DIODE	SILICO	018	DANA	211083
Q1	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q2	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q4	200035	TRANS	SILICO NPN	014	DANA	200035
A-R1	000122	RES	CARBON	1.2 K 5% 1/4 W	OHMITE	RC07GF122J
A-R3	000122	RES	CARBON	1.2 K 5% 1/4 W	OHMITE	RC07GF122J
B-R1	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
B-R3	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
C-R1	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
C-R3	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
D-R1	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
D-R3	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R2	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R4	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R8	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J
R9	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
R11	000204	RES	CARBON	200 K 5% 1/4 W	OHMITE	RC07GF204J
R12	000103	RES	CARBON	10 K 5% 1/4 W	OHMITE	RC07GF103J
R13	000103	RES	CARBON	10 K 5% 1/4 W	OHMITE	RC07GF103J
R14	001698	RES	CARBON	20 K 5% 1 W	OHMITE	RC32GF203J
R15	001107	RES	CARBON	39 K 5% 1 W	OHMITE	RC32GF393J
R16	000103	RES	CARBON	10 K 5% 1/4 W	OHMITE	RC07GF103J
R17	000103	RES	CARBON	10 K 5% 1/4 W	OHMITE	RC07GF103J
R18	000103	RES	CARBON	10 K 5% 1/4 W	OHMITE	RC07GF103J
R19	001107	RES	CARBON	39 K 5% 1 W	OHMITE	RC32GF393J
R20	001698	RES	CARBON	20 K 5% 1 W	OHMITE	RC32GF203J
R21	000333	RES	CARBON	33 K 5% 1/4 W	OHMITE	RC07GF333J
R22 THRU R26	000333	RES	CARBON	33 K 5% 1/4 W	OHMITE	RC07GF333J
R27	000223	RES	CARBON	22 K 5% 1/4 W	OHMITE	RC07GF223J

PCB APCB ASSEMBLY DECADE, BCD, BASIC - 400862

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
R28 THRU R30	000223	RES	CARBON	22 K 5% 1/4 W	OHMITE	RC07GF223J

PC BOARD ASSEMBLY NULL DETECTOR 4 DIGIT 400843

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C2	101175	CAP	CERAM	220 PFD 500 V 10%	AEROVOX	SCD1X5F
C3	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C4	110040	CAP	ELECT	1 MFD 50 V 20%	DUCATI	1-50
CR1	211083	DIODE	SILICO	018	DANA	211083
CR2	211083	DIODE	SILICO	018	DANA	211083
R1	000473	RES	CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R2	000333	RES	CARBON	33 K 5% 1/4 W	OHMITE	RC07GF333J
R3	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R4	040050	RES	VARI	5 K 10% 1/2 W	BOURNS	3067-P-1-K02
R5	020193					
R6	C00684	RES	CARBON	680 K 5% 1/4 W	OHMITE	RC07GF684J
R7	020194					
R8	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R9	000516	RES	CARBON	51 M 5% 1/4 W	OHMITE	RC07GF516J
R10	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R11	000133	RES	CARBON	13 K 5% 1/4 W	OHMITE	RC07GF133J
R12	000432	RES	CARBON	4.3 K 5% 1/4 W	OHMITE	RC07GF432J
R13	000246	RES	CARBON	24 M 5% 1/4 W	OHMITE	RC07GF246J
R14	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R15	000331	RES	CARBON	330 OHM 5% 1/4 W	OHMITE	RC07GF331J
R16	010113	RES	METAL	15 K 1% 1/4 W	ELECTRA	RN60D1502F
R17	000246	RES	CARBON	24 M 5% 1/4 W	OHMITE	RC07GF246J
R18	040049	RES	VARI	2 K 10% 1/2 W	BOURNS	3067-P-1-202
R19	010272	RES	METAL	154 K 1% 1/4 W	ELECTRA	RN60D1543F
R20	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R21	010113	RES	METAL	15 K 1% 1/4 W	ELECTRA	RN60D1502F
R22	010270	RES	WW	12.5 M 1% 1 W	PME	PME70T0
R23	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R24	010269	RES	WW	5 M 1% 1/2 W	PME	PME65T0
R25	000334	RES	CARBON	330 K 5% 1/4 W	OHMITE	RC07GF334J
R26	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R27	000123	RES	CARBON	12 K 5% 1/4 W	OHMITE	RC07GF123J
R28	010271					
R29	000242	RES	CARBON	2.4 K 5% 1/4 W	OHMITE	RC07GF242J
R30	C00113	RES	CARBON	11 K 5% 1/4 W	OHMITE	RC07GF113J
R31	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R32	000123	RES	CARBON	12 K 5% 1/4 W	OHMITE	RC07GF123J
R33	010298	RES	METAL	2.5 M .25% 1 W	PYROFILM	PME75T225M
R34	000334	RES	CARBON	330 K 5% 1/4 W	OHMITE	RC07GF334J

PC BOARD ASSEMBLY NULL DETECTOR 4 DIGIT 400843

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
R35	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R36	010297	RES	METAL	1.25 M 1% 1/2 W	PYROFILM	PME65T2215M
R37	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R38	001692	RES	CARBON	4.7 K 5% 1/2 W	OHMITE	RC20GF472J
R39	010267	RES	WW	500 K .1% 1/4 W	PME	PME60T2
R40	001703	RES	CARBON	8.2 K 5% 1/2 W	OHMITE	RC20GF822J
R41	001692	RES	CARBON	4.7 K 5% 1/2 W	OHMITE	RC20GF472J
R42	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R43	020198	RES	WW	250 K .05% 1/8 W	JORDAN	J-11
R44	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R45	020198	RES	WW	250 K .05% 1/8 W	JORDAN	J-11
R46	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
R47	000124	RES	CARBON	120 K 5% 1/4 W	OHMITE	RC07GF124J
R48	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R49	020197	RES	WW	125 K .05% 1/8 W	JORDAN	J-11
R50	020195	RES	WW	49.995 K .01% 1/8 W	JORDAN	J-11
R51 THRU R54	020196	RES	WW	24.995 K .01% 1/8 W	JORDAN	J-11
R55	020195	RES	WW	49.995 K .01% 1/8 W	JORDAN	J-11
Q1	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
A-Q2 THRU N-Q2 THRU V-Q2	200055					
P-Q2	200054					
Q3	200036	TRANS	SILICO NPN	015	DANA	200036
Q4 THRU Q9	200043	TRANS	SILICO NPN	2N3565	FAIRCHILD	2N3565

PCB APCB ASSEMBLY SEQUENCE LCGIC - 400688

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	100012	CAP	CERAM	33 PFD 500 V 10%	AEROVOX	TCD-N750
C10	101175	CAP	CERAM	220 PFD 500 V 10%	AEROVOX	SCD1X5F
CR1 THRU	211083	DIODE	SILICO	018	DANA	211083
CR7	211083	DIODE	SILICO	018	DANA	211083
CR25	211083	DIODE	SILICO	018	DANA	211083
Q1	200037	TRANS	SILICO	NPN 2N3646	FAIRCHILD	2N3646
Q2	200037	TRANS	SILICO	NPN 2N3646	FAIRCHILD	2N3646
R1	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R2	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R3	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R4	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R8	000123	RES	CARBON	12 K 5% 1/4 W	OHMITE	RC07GF123J
R10	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
B-R1	000822	RES	CARBON	8.2 K 5% 1/4 W	OHMITE	RC07GF822J
B-R2	000822	RES	CARBON	8.2 K 5% 1/4 W	OHMITE	RC07GF822J

PCB APCB ASSEMBLY CONTROL LOGIC - 400689

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	100012	CAP	CERAM	33 PFD 500 V 10%	AEROVOX	TCD-N750
C2	121473	CAP	MYLAR	.0015 MFD 100 V 10%	CDE	WMF1S47
C3	121468	CAP	MYLAR	.022 MFD 100 V 10%	CDE	WMF1S22
C4	101174	CAP	CERAM	.001 MFD 500 V 10%	AEROVOX	SCD3X5F
C5	120001	CAP	MYLAR	.0033 MFD 100 V 10%	CDE	WMF1D33
C6	110017	CAP	TANTA	1 MFD 35 V 10%	KEMET	K1C35K
C7	110039	CAP	ELECT	5 MFD 50 V 20%	DUCATI	5-50
C8	110039	CAP	ELECT	5 MFD 50 V 20%	DUCATI	5-50
C9	110043	CAP	ELECT	25 MFD 25 V 20%	DUCATI	25-25
CR1 THRU CR36	211083	DIODE	SILICO	018	DANA	211083
Q1 THRU Q4	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q5	200011	TRANS	SILICO PNP	009	DANA	200011
Q6 THRU Q9	200037	TRANS	SILICO NPN	2N3646	FAIRCHILD	2N3646
Q10	200035	TRANS	SILICO NPN	014	DANA	200035
Q11	200035	TRANS	SILICO NPN	014	DANA	200035
R1	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R2	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R3	000222	RES	CARBON	2.2 K 5% 1/4 W	OHMITE	RC07GF222J
R4	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R5	000622	RES	CARBON	6.2 K 5% 1/4 W	OHMITE	RC07GF622J
R6	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R7	000242	RES	CARBON	2.4 K 5% 1/4 W	OHMITE	RC07GF242J
R8	000822	RES	CARBON	8.2 K 5% 1/4 W	OHMITE	RC07GF822J
R9	000204	RES	CARBON	200 K 5% 1/4 W	OHMITE	RC07GF204J
R10	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
R11	000201	RES	CARBON	200 OHM 5% 1/4 W	OHMITE	RC07GF201J
R12	000243	RES	CARBON	24 K 5% 1/4 W	OHMITE	RC07GF243J
R13	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R14	000822	RES	CARBON	8.2 K 5% 1/4 W	OHMITE	RC07GF822J
R15	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R16	000153	RES	CARBON	15 K 5% 1/4 W	OHMITE	RC07GF153J
R17	000104	RES	CARBON	100 K 5% 1/4 W	OHMITE	RC07GF104J
R18	001469	RES	CARBON	1.2 K 5% 1/2 W	OHMITE	RC20GF122J

PCB APCB ASSEMBLY CONTROL LOGIC - 400689

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION			MANUFAC	MANUFAC P/N
R19	000203	RES	CARBON	20 K	5%	1/4 W	OHMITE	RC07GF203J
R20	000203	RES	CARBON	20 K	5%	1/4 W	OHMITE	RC07GF203J
R21	001469	RES	CARBON	1.2 K	5%	1/2 W	OHMITE	RC20GF122J
R22	000104	RES	CARBON	100 K	5%	1/4 W	OHMITE	RC07GF104J
R23	000153	RES	CARBON	15 K	5%	1/4 W	OHMITE	RC07GF153J
R24	000104	RES	CARBON	100 K	5%	1/4 W	OHMITE	RC07GF104J
R25	000222	RES	CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R26	000133	RES	CARBON	13 K	5%	1/4 W	OHMITE	RC07GF133J
R27	040003	RES	VARI	20 K	10%	1/2 W	BOURNS	3067-P-1-203
R28	000222	RES	CARBON	2.2 K	5%	1/4 W	OHMITE	RC07GF222J
R29	000104	RES	CARBON	100 K	5%	1/4 W	OHMITE	RC07GF104J
R30	000273	RES	CARBON	27 K	5%	1/4 W	OHMITE	RC07GF273J
R31 THRU R34	000103	RES	CARBON	10 K	5%	1/4 W	OHMITE	RC07GF103J
R35	000822	RES	CARBON	8.2 K	5%	1/4 W	OHMITE	RC07GF822J

PCB ASSEMBLY REFERENCE & BUFFER AMPLIFIER-400840

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	101098	CAP	CERAM	330 PFD 500 V 10%	AEROVOX	SCD1X5F
C2	101642	CAP	CERAM	150 PFD 500 V 10%	AEROVOX	SCD2X5F
C3	110040	CAP	ELECT	1 MFD 50 V 20%	DUCATI	1-50
C4	121093	CAP	MYLAR	.047 MFD 100 V 10%	CDE	WMF1S47
C5	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C6	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C7	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C8	120005	CAP	MYLAR	.001 MFD 100 V 10%		WMF1D1
C9	120005	CAP	MYLAR	.001 MFD 100 V 10%		WMF1D1
C10	101145	CAP	CERAM	100 PFD 500 V 10%	AEROVOX	SCD1X5F
C12	121092	CAP	MYLAR	.0022 MFD 100 V 10%	CDE	WMF1D22
CR1	220007	DIODE	SILICO ZENER	1N751	MOTOROLA	1N751
CR2	211236					
CR3	400842					
CR4	211083	DIODE	SILICO	018	DANA	211083
CR5	211083	DIODE	SILICO	018	DANA	211083
CR6	211236					
CR7	211236					
CR8	220012	DIODE	SILICO ZENER	1N958B	MOTOROLA	1N958B
CR9	220012	DIODE	SILICO ZENER	1N958B	MOTOROLA	1N958B
CR10	211083	DIODE	SILICO	018	DANA	211083
CR11	211083	DIODE	SILICO	018	DANA	211083
CR12	211083	DIODE	SILICO	018	DANA	211083
CR13	220004	DIODE	SILICO ZENER	1N961B	MOTOROLA	1N961B
R1	000512	RES	CARBON	5.1 K 5% 1/4 W	OHMITE	RC07GF512J
R2	400842					
R3	000300	RES	CARBON	30 OHM 5% 1/4 W	OHMITE	RC07GF300J
R4	400842					
R5	040050	RES	VARI	5 K 10% 1/2 W	BOURNS	3067-P-1-K02
R6	400842					
R7	000681	RES	CARBON	680 OHM 5% 1/4 W	OHMITE	RC07GF681J
R8	010158	RES	METAL	200 K 1% 1/4 W	ELECTRA	RN60D2003F
R9	040054	RES	VARI	50 K 10% 1/5 W	BOURNS	3068-P-1503
R10	010208	RES	METAL	182 K 1% 1/4 W	ELECTRA	RN60D1823F
R11	010158	RES	METAL	200 K 1% 1/4 W	ELECTRA	RN60D2003F
R12	000122	RES	CARBON	1.2 K 5% 1/4 W	OHMITE	RC07GF122J
R13	000101	RES	CARBON	100 OHM 5% 1/4 W	OHMITE	RC07GF101J
R14	000273	RES	CARBON	27 K 5% 1/4 W	OHMITE	RC07GF273J
R15	000242	RES	CARBON	2.4 K 5% 1/4 W	OHMITE	RC07GF242J

PCB ASSEMBLY REFERENCE & BUFFER AMPLIFIER-400840

P A R T S L I S T

REF DES	DANA P/N	PART TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
R16	000101	RES CARBON	100 OHM 5% 1/4 W	OHMITE	RC07GF101J
R17	000105	RES CARBON	1 M 5% 1/4 W	OHMITE	RC07GF105J
R18	C00622	RES CARBON	6.2 K 5% 1/4 W	OHMITE	RC07GF622J
R19	C00363	RES CARBON	36 K 5% 1/4 W	OHMITE	RC07GF363J
R20	C00622	RES CARBON	6.2 K 5% 1/4 W	OHMITE	RC07GF622J
R21					
R22	000242	RES CARBON	2.4 K 5% 1/4 W	OHMITE	RC07GF242J
R23	000102	RES CARBON	1 K 5% 1/4 W	OHMITE	RC07GF102J
R24	C00473	RES CARBON	47 K 5% 1/4 W	OHMITE	RC07GF473J
R25	CC0102	RES CARBON	1 K 5% 1/4 W	OHMITE	RC07GF102J
R26	CC0471	RES CARBON	470 OHM 5% 1/4 W	OHMITE	RC07GF471J
R27	CC0682	RES CARBON	6.8 K 5% 1/4 W	OHMITE	RC07GF682J
R28	C00240	RES CARBON	24 OHM 5% 1/4 W	OHMITE	RC07GF240J
R29	000240	RES CARBON	24 OHM 5% 1/4 W	OHMITE	RC07GF240J
R30	001702	RES CARBON	1.6 K 5% 1/2 W	OHMITE	RC20GF162J
R31	001702	RES CARBON	1.6 K 5% 1/2 W	OHMITE	RC20GF162J
R32	CC0102	RES CARBON	1 K 5% 1/4 W	OHMITE	RC07GF102J
R33	000681	RES CARBON	680 OHM 5% 1/4 W	OHMITE	RC07GF681J
Q1	200040	TRANS SILICO NPN	016	DANA	200040
Q2	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q3	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q4	200011	TRANS SILICO PNP	009	DANA	200011
Q5	200035	TRANS SILICO NPN	014	DANA	200035
Q6 THRU	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q9	200043	TRANS SILICO NPN	2N3565	FAIRCHILD	2N3565
Q10	200011	TRANS SILICO PNP	009	DANA	200011
Q11	200035	TRANS SILICO NPN	014	DANA	200035
Q12	200035	TRANS SILICO NPN	014	DANA	200035
Q13	200011	TRANS SILICO PNP	009	DANA	200011

PCB APCB ASSEMBLY POWER SUPPLY - 400707

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C1	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C8	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C11	120072	CAP	MYLAR	.01 MFD 600 V 10%	CDE	WMF651
C13	110041	CAP	ELECT	250 MFD 6 V 20%	DUCATI	250-6
C14	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
C15	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C17	010182					
CR1 THRU	210004	DIODE	SILICO	SD-4		
CR13	210004	DIODE	SILICO	SD-4		
CR14	220015	DIODE	SILICO	ZENER 1N967B	MOTOROLA	1N967B
CR15	220015	DIODE	SILICO	ZENER 1N967B	MOTOROLA	1N967B
Q1	200035	TRANS	SILICO	NPN 014	DANA	200035
Q2	200011	TRANS	SILICO	PNP 009	DANA	200011
R1	030008					
R2	031450					
R3	000202	RES	CARBON	2 K 5% 1/4 W	OHMITE	RC07GF202J
R4	030007					
R5	000151	RES	CARBON	150 OHM 5% 1/4 W	OHMITE	RC07GF151J
R6	000202	RES	CARBON	2 K 5% 1/4 W	OHMITE	RC07GF202J
R7	000151	RES	CARBON	150 OHM 5% 1/4 W	OHMITE	RC07GF151J
R8	030007					

PC BOARD ASSEMBLY POWER SUPPLY-5403 402316

P A R T S L I S T

REF DES	DANA P/N	PART	TYPE	DESCRIPTION	MANUFAC	MANUFAC P/N
C2	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C3	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C4	121088	CAP	MYLAR	.01 MFD 100 V 10%	CDE	WMF1S1
C5	120072	CAP	MYLAR	.01 MFD 600 V 10%	CDE	WMF651
C22	110041	CAP	ELECT	250 MFD 6 V 20%	DUCATI	250-6
C23	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C24	110036	CAP	ELECT	25 MFD 50 V 20%	DUCATI	25-50
C25	101142					
C26	101182	CAP	CERAM	47 PFD 500 V 10%	AEROVOX	TCD-N750
CR1	210004	DIODE	SILICO	SD-4		
THRU						
CR4	210004	DIODE	SILICO	SD-4		
CR7	210004	DIODE	SILICO	SD-4		
THRU						
CR17	210004	DIODE	SILICO	SD-4		
CR18	220015	DIODE	SILICO	ZENER 1N967B	MOTOROLA	1N967B
CR19	220015	DIODE	SILICO	ZENER 1N967B	MOTOROLA	1N967B
Q1	200035	TRANS	SILICO	NPN 014	DANA	200035
Q2	200011	TRANS	SILICO	PNP 009	DANA	200011
R1	031450					
R2	030008					
R3	000202	RES	CARBCN	2 K 5% 1/4 W	OHMITE	RC07GF202J
R4	000202	RES	CARBCN	2 K 5% 1/4 W	OHMITE	RC07GF202J
R5	000151	RES	CARBCN	150 OHM 5% 1/4 W	OHMITE	RC07GF151J
R6	000151	RES	CARBCN	150 OHM 5% 1/4 W	OHMITE	RC07GF151J
R7	030007					
R8	030007					

DANA LABORATORIES
Repair/Return Form

DANA MODEL NO. _____ SERIAL NO. _____

RETURNED ASS'Y. P/N _____ SERIAL NO. _____

PROPERTY OF _____

RETURN TO _____

DESCRIPTION OF TROUBLE _____

_____

_____

_____

_____

_____

_____

OPERATING CONDITIONS (ie: Environment, Source Z) _____

_____

_____

SIGNED _____ DATE _____

(USE BACK OF FORM IF NECESSARY)

REPAIR INFORMATION

(TO BE COMPLETED BY REPAIR FACILITY)

SYMPTOMS NOTED _____

_____

_____

_____

ACTUAL CAUSE _____

_____

_____

_____

_____

_____

REPAIRS REQUIRED _____

_____

_____

_____

SIGNED _____ DATE _____

RETURN TO USER FILE

5M 10-65 M

Warranty

It is the practice of Dana Laboratories, Incorporated, to manufacture only products of a quality that will merit customer satisfaction. The company recognizes that customer satisfaction is achieved, not only by delivering products meeting advertised performance specifications and having a high level of reliability, but also by honestly and efficiently fulfilling their warranty obligations as set forth below.

Dana Laboratories, Inc., agrees to correct, either by repair or replacement, any defect of material or workmanship in Dana-manufactured units or components which develop within one year after delivery of the equipment to the original purchaser — provided that the equipment has been subjected only to normal and proper use.

In the event of failure of any component delivered with Dana equipment, but not manufactured by Dana Laboratories, assistance will be given the customer in obtaining, from the original manufacturer, reasonable adjustment under that manufacturer's warranty.

Any item claimed to be defective during the warranty period must be returned to Dana Laboratories, Inc., with transportation charges prepaid. The item will be repaired and returned to the purchaser with return transportation prepaid by Dana unless, of course, the item is found not to be defective or found to be damaged by misuse — in which case it will be returned to the purchaser with repair and transportation billed collect.

DANA

M

Observatory

MP MASTER
MA30585